MEASURING ACCESSIBILITY FOR PEDESTRIANS, BICYCLISTS, AND TRANSIT RIDERS TO GROCERY STORES IN THE EXCELSIOR/OUTER MISSION NEIGHBORHOODS OF SAN FRANCISCO

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By

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Title: Measuring Accessibility For Pedestrians, Bicyclists, And Transit Riders To Grocery Stores In The Excelsior/Outer Mission Neighborhoods Of San Francisco

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ABSTRACT

Measuring Accessibility For Pedestrians, Bicyclists, And Transit Riders To Grocery Stores In the Excelsior/Outer Mission Neighborhoods of San Francisco

Alexandra Lee-Gardner

Grocery stores are an important amenity in neighborhoods and access to grocery stores is important for health and well-being. While grocery store accessibility is a popular topic of research, studies measuring access for pedestrians, bicyclists, and transit riders are extremely rare. When a new store opened in the Excelsior/Outer Mission districts of San Francisco on a street lacking basic infrastructure for pedestrians, bicyclists, and transit riders, the importance of this study became apparent. The Excelsior/Outer Mission neighborhood has a shocking number of collisions (over 1,100 between 2015 and 2019), elevated levels of walking, biking, and transit ridership, and minimal safe infrastructure for these modes compared to other residential areas in San Francisco. To account for the effects of these conditions on accessibility, a rating system to measure infrastructure for users was used in addition to the more traditional gravity model.

Combining results into a composite accessibility score highlights how using only a gravity model to measure accessibility may conceal some of the nuances of accessibility as perceived by pedestrians, bicyclists, and transit riders. While it appears from gravity indices that stores in the Excelsior/Outer Mission are only slightly less accessible, the sensitivity analysis shows that infrastructure can have a large effect on overall accessibility. Specifically in the Excelsior/Outer Mission neighborhood, with its rather low infrastructure scores, the higher the weight attributed to the importance of infrastructure the lower is composite accessibility.

Rather than measuring accessibility using only travel time via a gravity model or other spatial model, this study shows the importance of combining physical proximity measurements with

infrastructure information to provide a more complete picture. This is particularly important for those walking, biking, or riding transit where safety is an important consideration. This study provides one such way to include the unique considerations of pedestrians, bicyclists, and transit riders by including an infrastructure scoring system. Not only does this highlight the importance of including infrastructure measures, but it provides a framework for future infrastructure improvements around stores.

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1 Introduction

1.1 Study problem

In April of 2021, a new H Mart grocery store, which is the first ever major Korean grocery store opened just outside of the Excelsior/Outer Mission districts of San Francisco. Prior to the store's opening, the lot had been vacant for eight years, since the preceding Asian market had closed in 2013 (Mullaney, 2021). At the store's opening, San Francisco's Mayor, London Breed, commented on the importance of this grocery store in increasing food access and boosting the local economy, especially in the context of the ongoing pandemic and the Asian hate movement saying, "The community has been asking for a grocery store for a long time, and we are glad to see this space finally being filled. This new store will provide local jobs and make it easier for the neighborhood to access quality food and help support our economic recovery as we emerge from this pandemic." (Mullaney, 2021). The grocery store provides 150 part and full time jobs and fills a gap in food access.

While the new H Mart is a win for grocery store accessibility, there are some caveats. For one, the H Mart is located right off of a freeway exit, making access much more difficult for those without a car. In fact, many of the grocery stores surrounding this area are difficult to reach without the use of a personal vehicle. Though most food accessibility standards look only at vehicle distance or vehicle travel time as factors of accessibility, these standards are less relevant to the Study Area as many residents in this neighborhood are low-income and significantly less likely to own a car (Nettles, 2012; Vojnovic et al., 2020). Furthermore, the Excelsior/Outer Mission is geographically small and compact, meaning distances to stores are relatively short, but lack of safe infrastructure continues to make it difficult to access any of these stores without a car (Lee-Gardner, 2020).

Accessibility refers to the ease of reaching a destination, such as a grocery store, most often measured in terms of time or distance and the number of opportunities to reach a store (Litman, 2022).

However, most studies fail to incorporate other factors of accessibility that are important to transit riders, pedestrians, and bicyclists, such as the quality of infrastructure (Jiao & Azimian, 2021; Tenkanen et al., 2016). Stores should be accessible by modes other than personal vehicles. This can reduce car dependency and provide opportunities for those who do not own a personal vehicle. Given this metric of accessibility which incorporates safe infrastructure considerations and road conditions, this study aims to answer the following questions:

1) How accessible are grocery stores in the Excelsior/Outer Mission district for pedestrians, bicyclists, and transit riders?
2) What is the best way to measure accessibility for pedestrians, bicyclists, and transit riders?

1.2 Literature review

1.2.1 Modes of travel to the store

Although driving is often considered the default and primary mode of travel to the grocery store, that is not necessarily accurate for all populations, particularly as income decreases (Vojnovic et al., 2020). Low-income households are six to seven times less likely to own a car compared to other U.S households (Nettles, 2012). When traveling to the grocery store, 20% to 50% of low-income individuals are likely to use non-motorized modes, such as walking and biking (Vojnovic et al., 2020). Households at or below the poverty threshold are less likely to drive their own vehicle (62%) to the store compared to households above the poverty line (84%-95%) (Ploeg, 2015). Instead, these households below the poverty threshold are found to use other modes such as walking, biking, or using transit (Ploeg, 2015). Furthermore, recipients of Supplemental Nutrition Assistance Program (SNAP), which account for 22% of all households with children under 18 in the Study Area, are less likely to drive a personal vehicle (Ploeg, 2015; U.S Census, 2019). A study with the U.S Department of Agriculture found that rather than driving alone, 13% of SNAP participants relied on transit and 21% relied on a ride for grocery store trips (Ploeg, 2015).

Researchers at Michigan State University created an agent based model of grocery store travel behaviors in Detroit, Michigan (Vojnovic et al., 2020). The results showed that 40% to 50% of grocery store trips for young very low-income people were made by walking or biking up to 7.5 miles. Young low-income people had similarly high rates of non-motorized trips but switched to motorized trips after 3 miles. The model revealed that other aged very low-income agents performed 20% to 40% of trips using non-motorized modes up to 5 miles (Vojnovic et al., 2020).

In San Francisco, overall car ownership and car use rates are lower than the United States average. In 2016, 30% of households in San Francisco did not own a car regardless of income level (Lee-Gardner, 2020). Furthermore, the Excelsior/Outer Mission population is largely very low-income, meaning there is likely a higher proportion of households that do not own a car (Nettles, 2012). In place of driving, these families are likely to rely on transit and nonmotorized modes (Vojnovic et al., 2020). Although about 89% of households in the Study Area report owning at least one vehicle, over 52% of the neighborhood population takes some other mode instead of driving alone to get to work (U.S Census, 2019). This emphasizes the need for accessibility measures that consider trips taken by walking, biking, and transit as many grocery store trips are likely taken using these modes.

Moreover, traveling by private vehicle can be expensive, particularly for low-income households (Rice, 2004). In the Bay Area, private vehicle expenditures make up 19% of the household budget for low-income families, compared to only 16% for high income families (Rice, 2004). Therefore, it is important that there are safe and convenient alternative transportation options that are affordable, so households do not need to drive to the store.

1.2.2 Distance and other accessibility metrics

Access to grocery stores is a very popular focus of research; however these studies focus primarily on distance and travel time for automobiles as deciding factors of accessibility. This stands contrary to

the literature which finds that households often do not shop at the grocery store nearest to their residence regardless of income level (McGuirt et al., 2018; Ploeg, 2015; Wilde et al., 2017). Households regularly travel on average 4 miles to shop, despite living on average 1.2 miles from the nearest store (McGuirt et al., 2018). Similarly, another study funded by the U.S Department of Agriculture found that SNAP recipients who traveled to the store using modes other than a car, lived on average 0.5 miles from a supermarket, but traveled 0.92 miles to their primary store (Ploeg, 2015). Three separate studies looking at grocery shopping behaviors found that food price was the highest rated reason for store selection over location (McGuirt et al., 2018; Ploeg, 2015; Wilde et al., 2017). Although location was usually a prominent factor, it was largely not the major determinant for grocery shoppers (McGuirt et al., 2018; Ploeg, 2015; Wilde et al., 2017).

This information about travel behavior coincides with research which concludes that distance or travel time alone is not an accurate indicator of accessibility especially for those who do not use a personal vehicle (Niedzielski, 2021; Widener, 2017). Many accessibility studies include other metrics beyond distance to the closest store, such as opportunity, which is measured by the number of available stores within a certain boundary (Niedzielski, 2021; Widener, 2017). The boundaries are determined by travel time and the size of the boundaries vary depending on the mode of travel. Two studies, one through the University of Toronto and the other from the Polish Academy of Sciences, used both opportunity and travel distance as metrics for accessibility (Niedzielski, 2021; Widener, 2017). Both studies concluded that due to differences in spatial patterns, neither metric alone, was sufficient in measuring accessibility (Niedzielski, 2021; Widener, 2017). This was particularly notable for transit trips compared to trips using a personal vehicle (Niedzielski, 2021; Widener, 2017).

Despite research showing that distance or travel time alone is not a sufficient metric of grocery store accessibility, it is still widely used in research and as a guide for policy and decision making

(Niedzielski, 2021; Swayne & Lowery, 2021; Widener, 2017). Access to grocery stores is one of the factors contributing to California's Healthy Place Index, which provides relative scores reflecting community conditions and is used widely in local and regional policy development (Public Health Alliance of Southern California, n.d.). The methodology for scoring grocery store access, an element of a jurisdiction's overall score, is based solely on distance. The score is determined by the "percentage of people in urban areas who live less than a half mile from a supermarket/large grocery store, or less than one mile in rural areas" (Public Health Alliance of Southern California, n.d.). In San Francisco, 90% of people live within a half mile of a supermarket, but that does not mean 90% of people can access a grocery store particularly if lack of infrastructure precludes them from doing so (Public Health Alliance of Southern California, n.d.). A total of three tracts in San Francisco have less than 50% of the population living within a half mile of a store. These tracts are on the southern edge of Visitacion Valley, the outskirts of Bayview, and Treasure Island. All other tracts have scores ranging from 60% to 100% (Public Health Alliance of Southern California, n.d.).

1.2.3 Access by alternative modes

There is very minimal research on grocery store accessibility by non-motorized modes (Tenkanen et al., 2016). Recently, studies have begun incorporating transit access as a comparison to vehicle access; incorporating alternative modes is vital to understanding access (Tenkanen et al., 2016). A 2021 study of San Diego found that travel times by transit were on average 3.5 times longer than travel times by personal vehicle (Swayne & Lowery, 2021). And while 98% of tracts were within a 10-minute drive to a store, only 30% where in a 10 minute public transit ride (Swayne & Lowery, 2021).

The literature on walking and biking is even more sparse. One study looking at food pantry clients found that 59% of clients did not live within reasonable walking distance to a store (Algert et al., 2006). A study in Melbourne, Australia calculated travel times for walking, busing, and driving to the nearest store (Burns & Inglis, 2007). They found that while over 80% of residents lived within an 8 to 10-minute

drive of a store, only 50% of the population could reach a store by bus in 8 to 10 minutes, and only 4% could reach a store by foot in the same time (Burns & Inglis, 2007). By overlaying low-income data, the researchers showed that lower income areas had less access to stores and more access to fast food establishments across modes (Burns & Inglis, 2007). A third study determined accessibility, measured by travel time, for different modes by modeling travel times extrapolated from travel diaries (Jiao & Azimian, 2021). This presents a different method of accessibility analysis that uses individual data rather than aggregated or calculated travel times. Although all these studies are groundbreaking in that there are few studies on walking or biking access to stores, they do not adequately measure access (Niedzielski, 2021; Widener, 2017). The studies use methods such as shortest distance or smallest travel time which may not be a statistically reliable method for modes other than driving and is not reflective of actual shopping travel behaviors (McGuirt et al., 2018; Niedzielski, 2021; Ploeg, 2015; Widener, 2017; Wilde et al., 2017).

However, none of these models consider environmental factors such as street conditions to understand accessibility. Regardless of distance, lack of infrastructure and perceived safety will prohibit people from walking, biking, or taking transit (Lin et al., 2019). High speed streets, low density of traffic signals, and high density of convenience stores, as exists in the Study Area is likely to increase the crash frequency (Lin et al., 2019). Additionally, lack of pedestrian, bike, and transit infrastructure further inhibits people from using these modes (Azad et al., 2021). Therefore, it is imperative that we incorporate these factors into accessibility measurements.

There are two common methods of measuring pedestrians' and bicyclists' comfort and safety: level of service analysis and level of stress analysis. The Highway Capacity Model includes level of service (LOS) as a method of evaluating capacity and functionality of pedestrian and bicycle facilities (Highway Capacity Manual, 2016). However, for pedestrians, this method focuses primarily on capacity of the

sidewalk and volume of pedestrians. While capacity and sidewalk width are important to pedestrians, this method neglects to include many other infrastructure aspects that are vital to pedestrian comfort, such as quality of crosswalks (Azad et al., 2021 & Lin et al., 2019). LOS for bicyclists incorporates vehicle speed and width of the bike lane, however, similar to pedestrian LOS, this method does not consider infrastructure, specifically the level of separation from vehicles as identified by the bicycle classification.

Level of stress, first developed by Mekuria et al. (2016), is another commonly used method of measuring comfort and safety. This method rates the level of stress pedestrians and bicyclists feel on the network. Unlike LOS, level of stress considers network connectivity, existence and quality of infrastructure, and other environmental factors that affect comfort. However, level of stress, although link based, is developed to be a "network evaluation tool" (Mekuria et al., 2016). Both pedestrian level of traffic stress (PLTS) and bicyclist level of traffic stress (BLTS) boil down the information to an assessment of "potential feel" of the users and in so doing divert attention from the condition of the infrastructure itself. While both level of service and level of stress measure important contributors to accessibility for pedestrians and bicyclists, neither method focuses on the presence and quality of the infrastructure as its outcomes.

1.3 Study purpose

The literature review shows that disparity in car access is widely accepted. Additionally, there are a number of behavioral studies and surveys observing that a considerable proportion of low-income households walk, bike, or ride transit to the grocery store. Yet, curiously, there is minimal research on store accessibility by modes other than a personal vehicle, particularly non-motorized modes.

Furthermore, studies fail to incorporate other factors of accessibility that are important to transit riders, pedestrians, and bicyclists, such as the quality of infrastructure. This study aims to fill that gap in the literature by providing a methodology for considering overlooked aspects of accessibility such as

infrastructure and by considering access by other modes such as pedestrians, bicyclists, and transit riders. This study is therefore proposing to score the elements of the infrastructure that are gathered at the segment level (for instance, for the PLTS and BLTS analyses) to create aggregate scores on "availability and conditions of physical infrastructure", which may be expressed as infrastructure quality.

2 Background

This section describes characteristics of the Study Area to provide context for the rest of the study. Additionally, this section details the stores in the area and explains the prevailing conditions that justify this study.

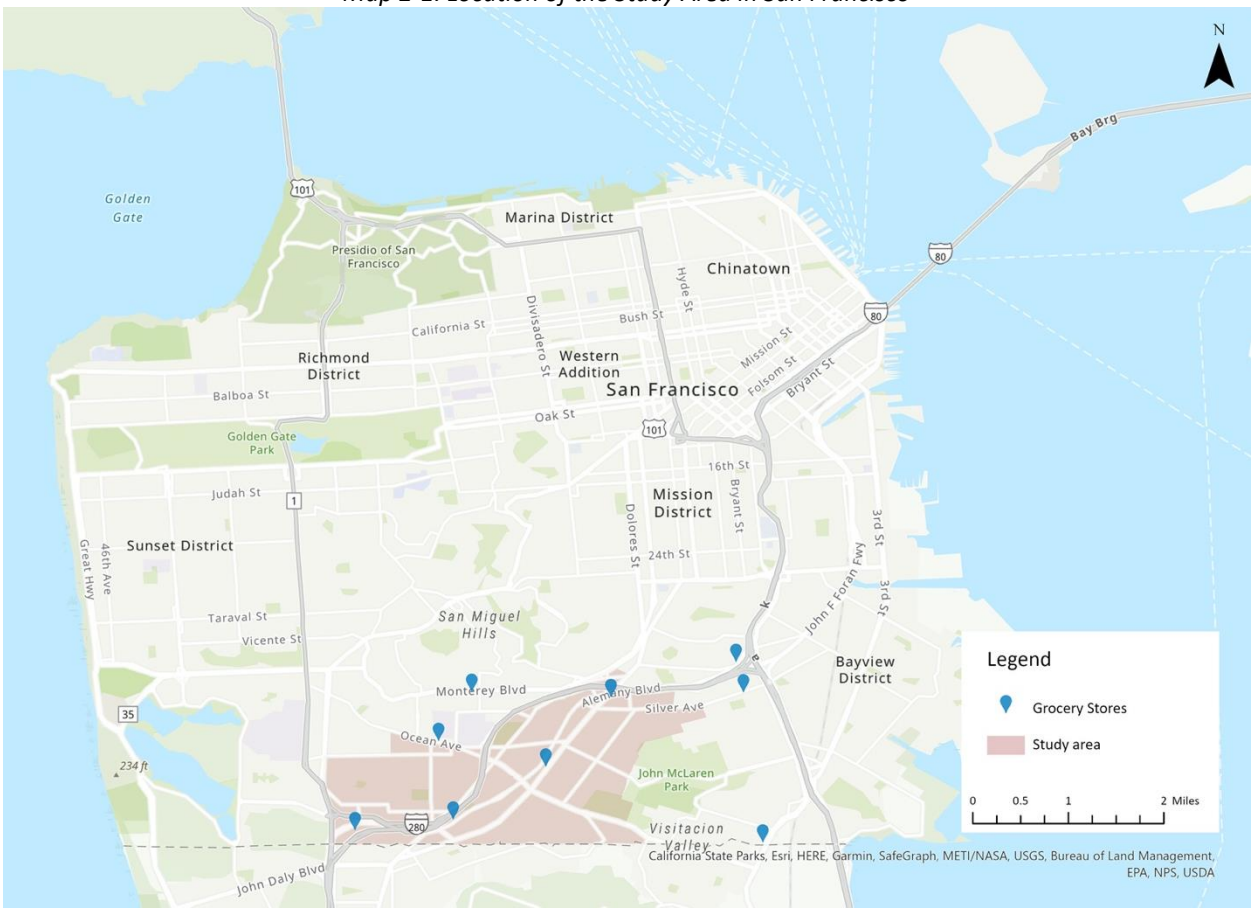
2.1 The study area

2.1.1 Location and demographics

The Study Area, shaded in red on Map 2.1, focuses on the Excelsior/Outer Mission neighborhoods of San Francisco. Despite its location on the edge of the city, the Excelsior/Outer Mission is a strong community with a vibrant commercial corridor and strong cultural identity. Diversity is also a point of pride for the community according to a survey conducted by the Planning Department in 2017 (San Francisco Planning Department, 2020). Of the over 60,000 residents in the Study Area, 51% identify as Asian, and 31% are of Hispanic or Latino origin (U.S Census, 2017). Compared to San Francisco, which is 47% white, only 24% of the population within the Excelsior/Outer Mission area identifies as white. Additionally, 71% of Study Area population speaks a language other than English at home (Census Bureau, 2017).

The majority of households in the Excelsior/Outer Mission are low-income to very low-income. In San Francisco, low-income is defined as having a household income less than $129,150 a year and households making under $80,600 are considered “very low-income” (HUD, 2019). The median household income in The Excelsior/Outer Mission is $79,375, meaning most families in this area are very low-income by these standards (U.S Census, 2017).

Map 2-1: Location of the Study Area in San Francisco



Source: (City of San Francisco, 2022)

This is significant because vehicle ownership rates are significantly lower for low-income families (Rice, 2004). In California, only two thirds of low-income families owned a vehicle compared to 90% for higher income households. Furthermore, only 73% of low-income Bay Area residents reported having access to a car, while 94% of higher income households reported having car access (Rice, 2004). These lower levels of car ownership among low-income families further emphasizes the need for adequate routes to grocery stores for pedestrians, bicyclists, and transit riders.

2.2 Grocery stores

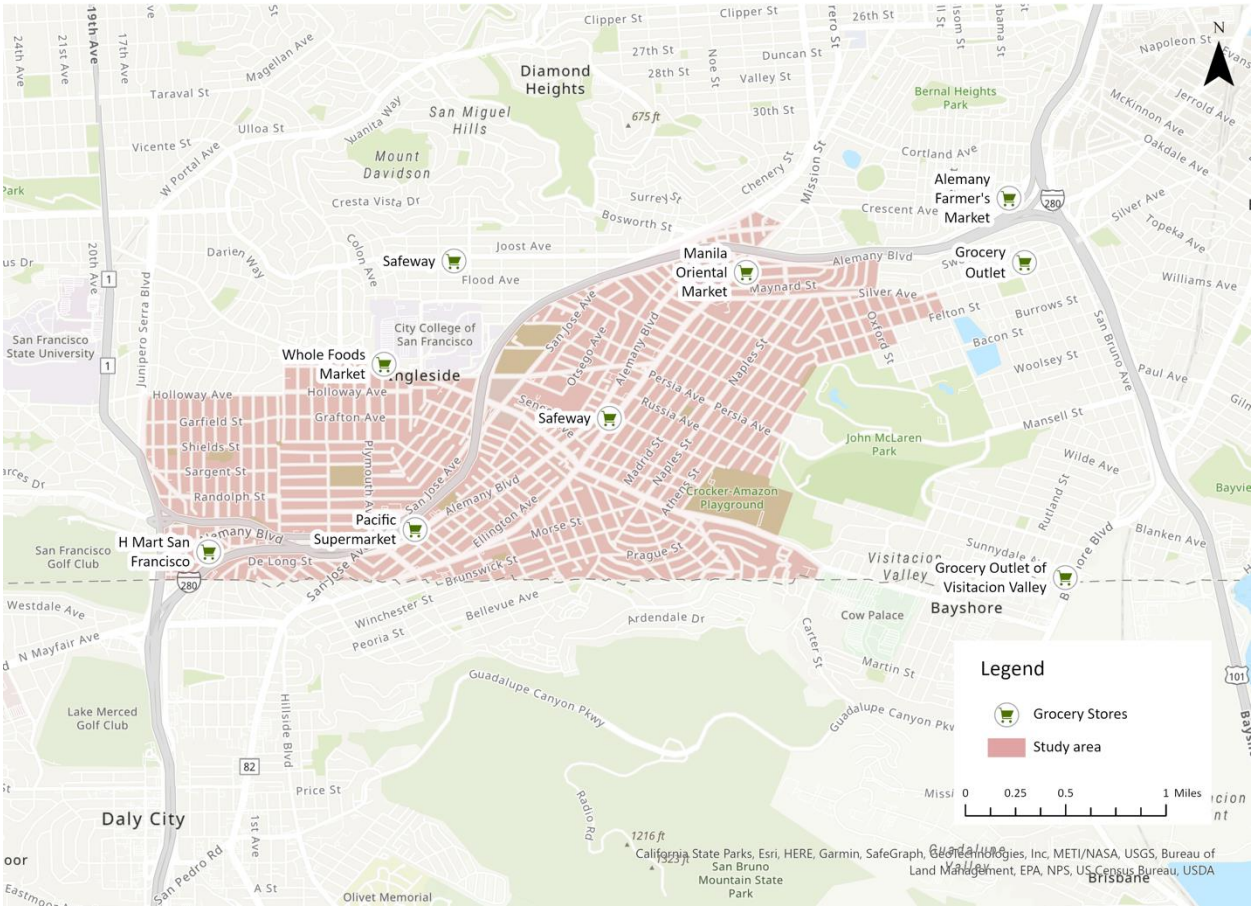
There are five grocery stores within the Study Area, as Map 2-2 shows. The grocery stores within

the Study Area are:

1. Manilla Oriental Market on Mission Street
2. Safeway on Mission Street
3. Whole Foods on Ocean Avenue
4. H Mart on Alemany Boulevard
5. Pacific Supermarket on Alemany Boulevard

There are also three other stores (a Safeway and two Grocery Outlets) that are located less than a mile outside of the Study Area. Lastly, the Alemany Farmers' Market is located a mile to the east of the Study Area.

Map 2-2: Grocery stores in the Study Area



Source: (Google, 2022)

2.2.1 Alemany Farmers' Market

Although there are many farmers' market locations in San Francisco, the Alemany Farmers' Market is the oldest and one of the largest in the city (City and County of San Francisco, n.d.). This market is an institution; founded in 1943, Alemany is the first farmers' market in California and the oldest in San Francisco (City and County of San Francisco, n.d.). Unlike other popup farmers' markets, the Alemany Farmers' Market has dedicated concrete stalls covered in colorful murals. When the market is not in session, the location is used for drive-up COVID-19 testing funded by the City (City and County of San Francisco, n.d.).

Given that farmers' markets are often associated with affluent neighborhoods, the proximity of this market to the Study Area is significant. It offers another option for healthy, fresh produce at reasonable prices. However, as seen on Figure 2-1, the location of the farmers' market is at the corner of U.S Route 101 and Interstate 280. In this area, Alemany Boulevard serves as an arterial with very high vehicle speeds. The sidewalks are extremely narrow. There are bike lanes on this section of Alemany Blvd which are protected eastbound, but only provide a painted buffer in the westbound direction. The intersection near the entrance to the market is very busy and rather complex as it also serves as the off-ramp for US 101 and I-280 as Figure 2-1 shows. For pedestrians and bicyclists, it involves crossing six lanes of traffic, which is a significant obstruction. Furthermore, Interstate 280 serves as a barrier from the Study Area to the Alemany Farmers' Market. Alemany Blvd and Mission Street both cross the freeway, but neither have bicycle facilities crossing I-280. Though both have sidewalks, they do not provide adequate comfort or safety, as they are very narrow.

Figure 2-1: Street conditions at the Alemany Farmers' Market

Source: (Google Earth, 2022; Lee-Gardner, 2022)

2.3 Existing conditions

Many people in the Excelsior/Outer Mission walk, bike, and ride transit for a variety of trip purposes. For work commuting trips, one third of the district's population takes public transit (San Francisco Planning Department, 2020). When the San Francisco Planning Department took stock of transportation behaviors in the area in 2017 as part of a neighborhood plan, the agency reported that most trips for residents included walking as part of the trips. Furthermore, 63% of respondents identified walking as their primary mode to accessing the commercial corridors in the neighborhood (San Francisco Planning Department, 2020).

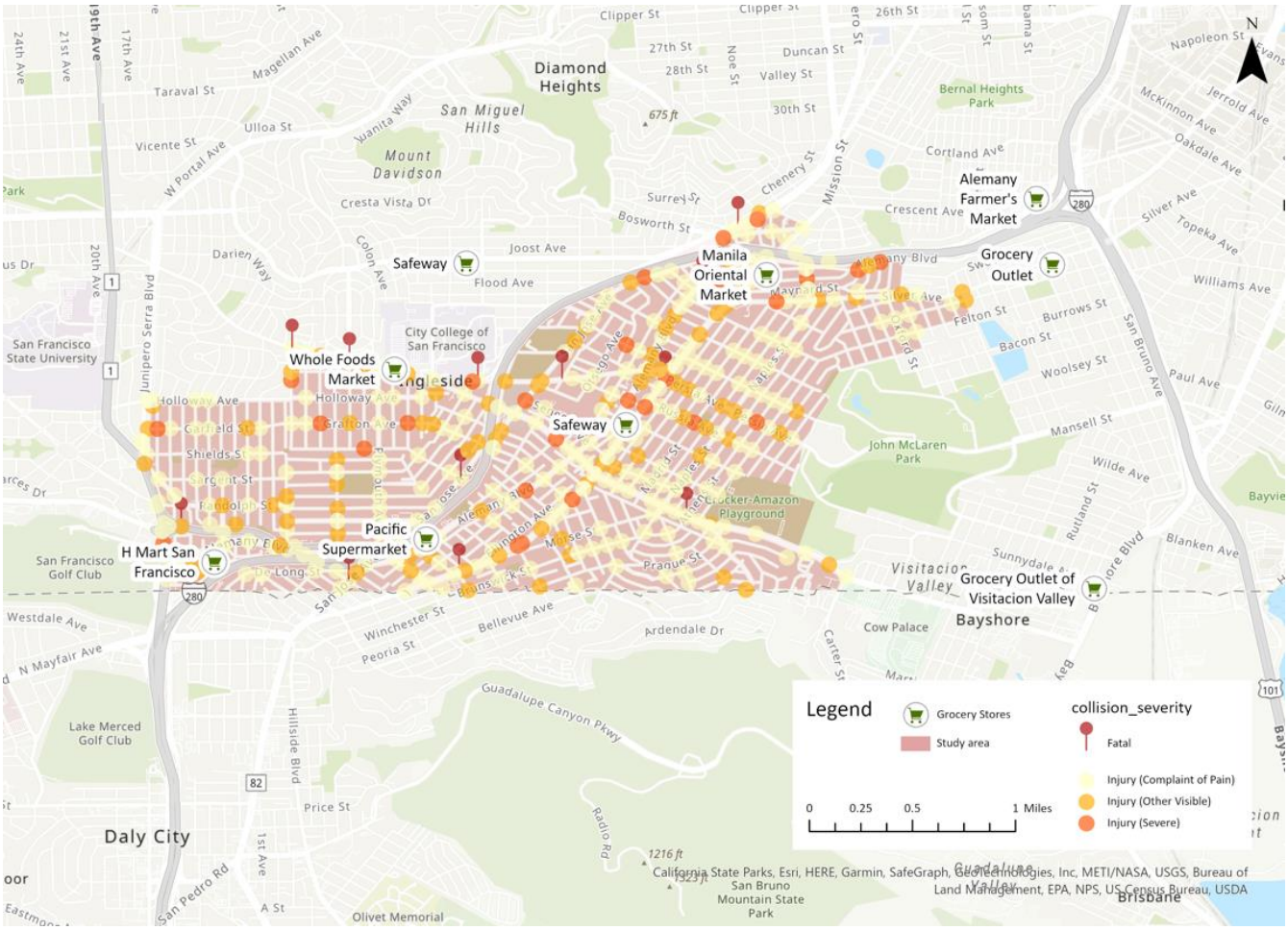
2.3.1 Bicycle and pedestrian safety

Despite the high walking levels, only 30% of survey respondents felt safe and comfortable walking along main streets in the area (San Francisco Planning Department, 2020). High vehicle speeds and lack of adequate infrastructure along major roadways in the Excelsior/Outer Mission has led to extremely high collision levels. Over 1,100 collisions have occurred within the Study Area in a five-year period from 2015 to 2019 (City of San Francisco , n.d.). Of these collisions, 84 resulted in severe injury for one or more people, and 13 collisions resulted in a fatality. One third of all collisions and over half of all collisions that resulted in a severe injury or fatality involved pedestrians and bicyclists (City of San Francisco , n.d.). Map 2-3 shows all collisions in the Study Area by severity; crash locations are concentrated along major streets such as Mission Street, Alemany Boulevard, Ocean Avenue, and Geneva Street. The majority of fatal crashes, represented by dark red pins, also occurred on these streets. These streets are all considered to be on San Francisco's High Injury Network. This network represents the highest concentrations of crashes in the City (San Francisco Planning Department, 2020). All five of the grocery stores in the Study Area, represented by green grocery store icons, are located on streets that are part of the High Injury Network and are prone to high collision rates.

Given the high proportion of streets in the Excelsior/Outer Mission that are part of the High Injury Network, San Francisco Municipal Transportation Agency (SFMTA) has been working to improve safety conditions in the area through a number of projects implemented since 2018. An analysis of these projects found many promising elements of the planned designs that would help to provide safe spaces for pedestrians and bicyclists (Lee-Gardner, 2020). However, the plans and current projects still lack adequate protections near grocery stores. For example, the street that the new H Mart is located on has low sight distance and high vehicle speeds and no infrastructure to ease protection and visibility for pedestrians and bicyclists, as seen in Figure 2-2. In fact, many intersections throughout the Study Area need improvement. Collision data from 2015-2019 found that 76% of all pedestrian-vehicle crashes

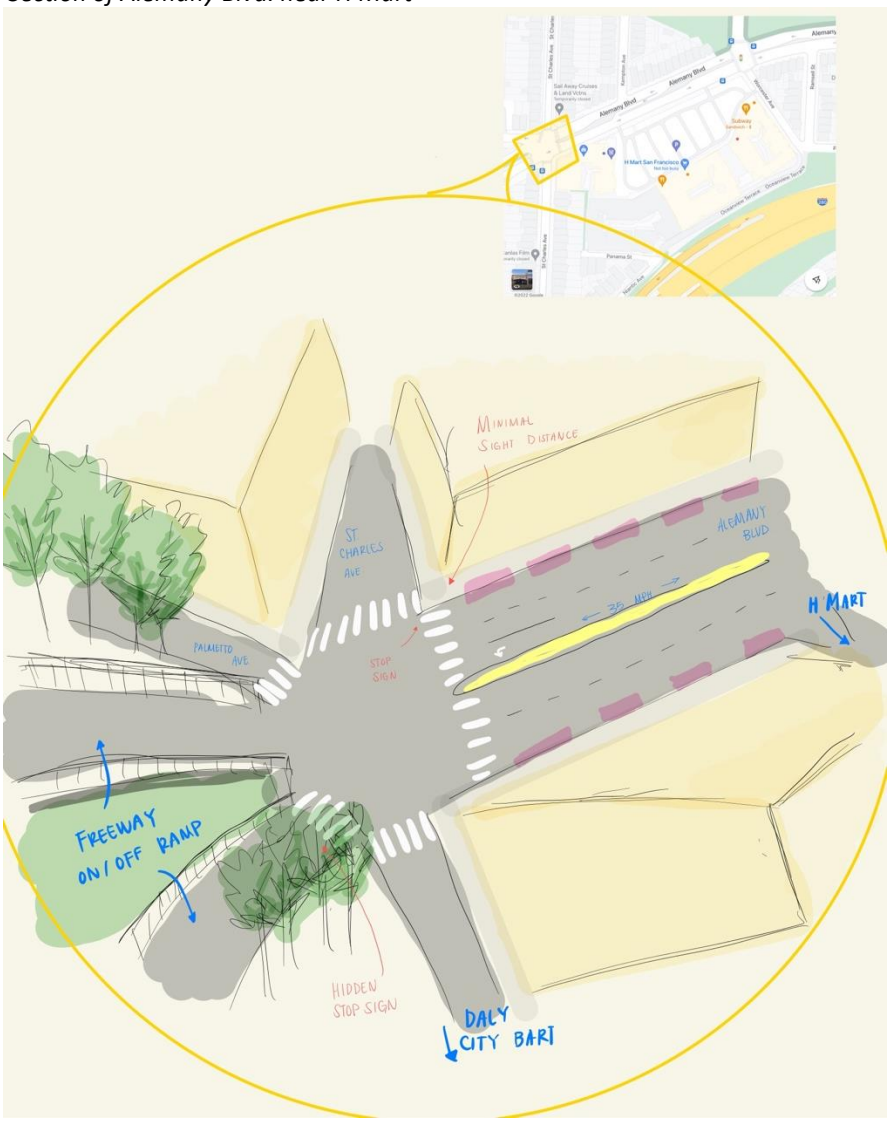
occurred at an intersection (City of San Francisco , n.d.). Despite the risks for pedestrians at intersections, many of the residential streets in the Area do not have crosswalks. On larger streets, most intersections have crosswalks, but high vehicle speeds and low visibility at intersections continue to cause unsafe conditions for pedestrians.

Map 2-3: Collisions by Severity in Study Area, 2015-2019



Source: (City of San Francisco , n.d.)

Figure 2-2: Cross-Section of Alemany Blvd. near H Mart



Source: (Lee-Gardner, 2022)

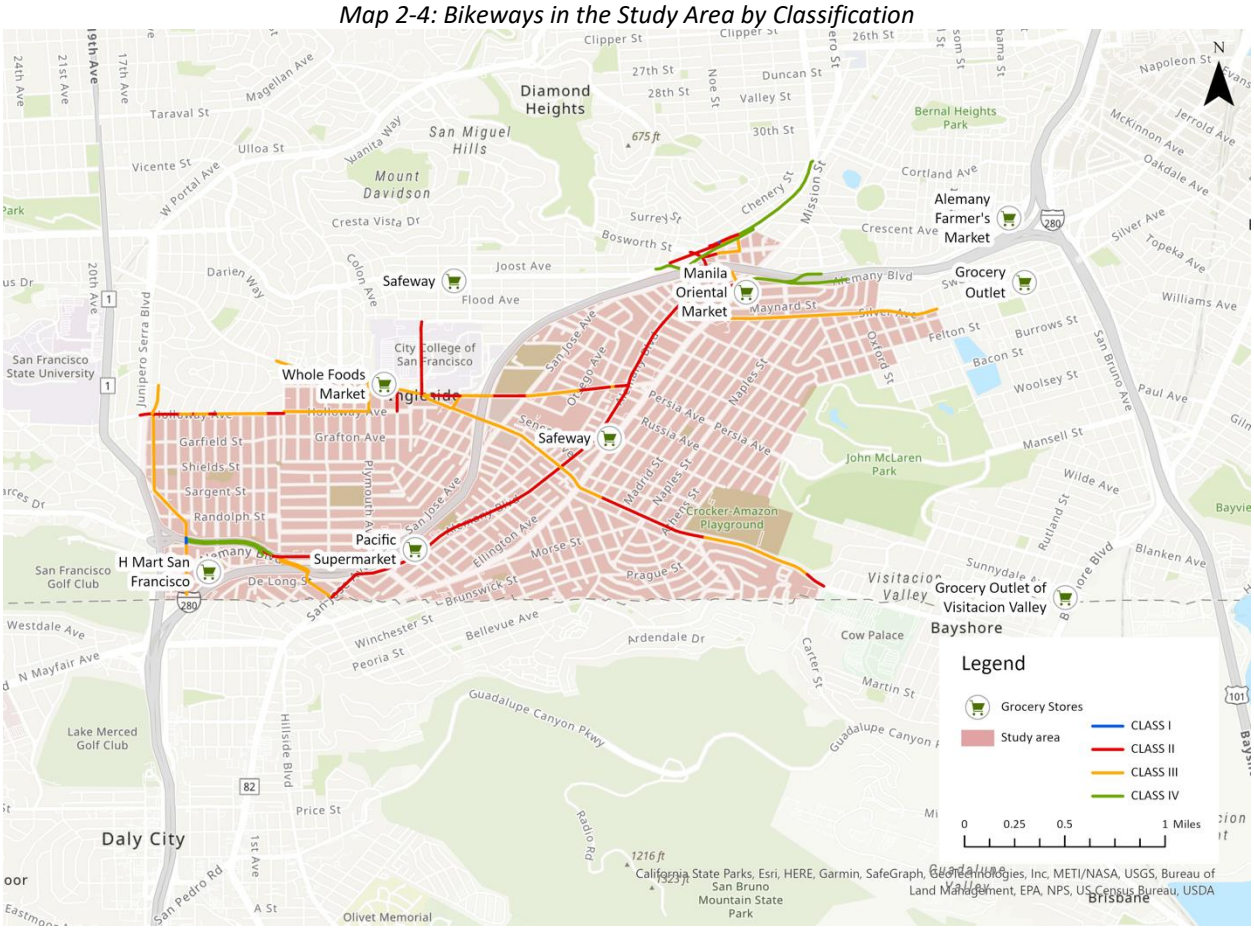
Additionally, most of the Excelsior/Outer Mission lacks adequate bike facilities. Map 2-4 shows the bike lanes in the Study Area by class. There are four classes of bike facilities:

- **Class I bike paths** are physically separate from roadways. They are perhaps the safest class but require substantial amounts of right-of-way. There is less than half a mile of Class I bike lanes in the Study Area.
- **Class II bike lanes** are part of the roadway and are delineated by a white stripe. In San Francisco, the City often colors the whole lane in green paint to increase visibility. While

these bike lanes are useful for smaller streets with lower levels of vehicle traffic, they do not offer enough protection for higher speed streets such as Geneva St., Mission St., Alemany Blvd., or Ocean Ave.

- **Class III shared ways** share the road with vehicles. They are often marked by signs and painted icons indicating vehicles should share the road. This is an appropriate treatment for residential streets with low vehicle volumes and slow speeds. They are not appropriate for through streets. However, adding more Class III bike ways along residential streets can improve wayfinding for bicyclists.
- **Class IV separated bike lanes** are part of the roadway but are separated from vehicle lanes by a physical barrier or buffer. These bike lanes provide high protection for bicyclists and are ideal for high volume streets with high speeds. Unfortunately, Class IV bike lanes make up a small portion of all bike lanes (San Francisco Municipal Transportation Agency, 2022). To ensure adequate safety, major through streets such as Geneva St., Alemany Blvd., Mission St., and Ocean Ave, need Class IV separated bike lanes.

Map 2-4: Bikeways in the Study Area by Classification



Source: (SFMTA, 2022)

The City has improvement plans for Alemany Boulevard as well as Mission and Geneva Streets. On Alemany, plans indicated the City would provide painted bike lanes, however given the high speed of vehicle traffic, a buffered or protected bike lane is needed to provide adequate safety. The design for Mission and Geneva Streets would greatly increase safety for both pedestrians and bicyclists by widening sidewalks and improving sight distance for pedestrians as well as implementing protected bike lanes and reducing collision conflicts for bicyclists (Lee-Gardner, 2020). The project is also expected to include bus only lanes to improve bus service and increase safety and efficiency at bus stops (Lee-Gardner, 2020). However, construction, which was initially set to begin in summer 2020 has yet to begin as of May 2022. The City predicts that construction will now likely start in summer of 2022 and be completed in fall of 2025 (Chong, 2017).

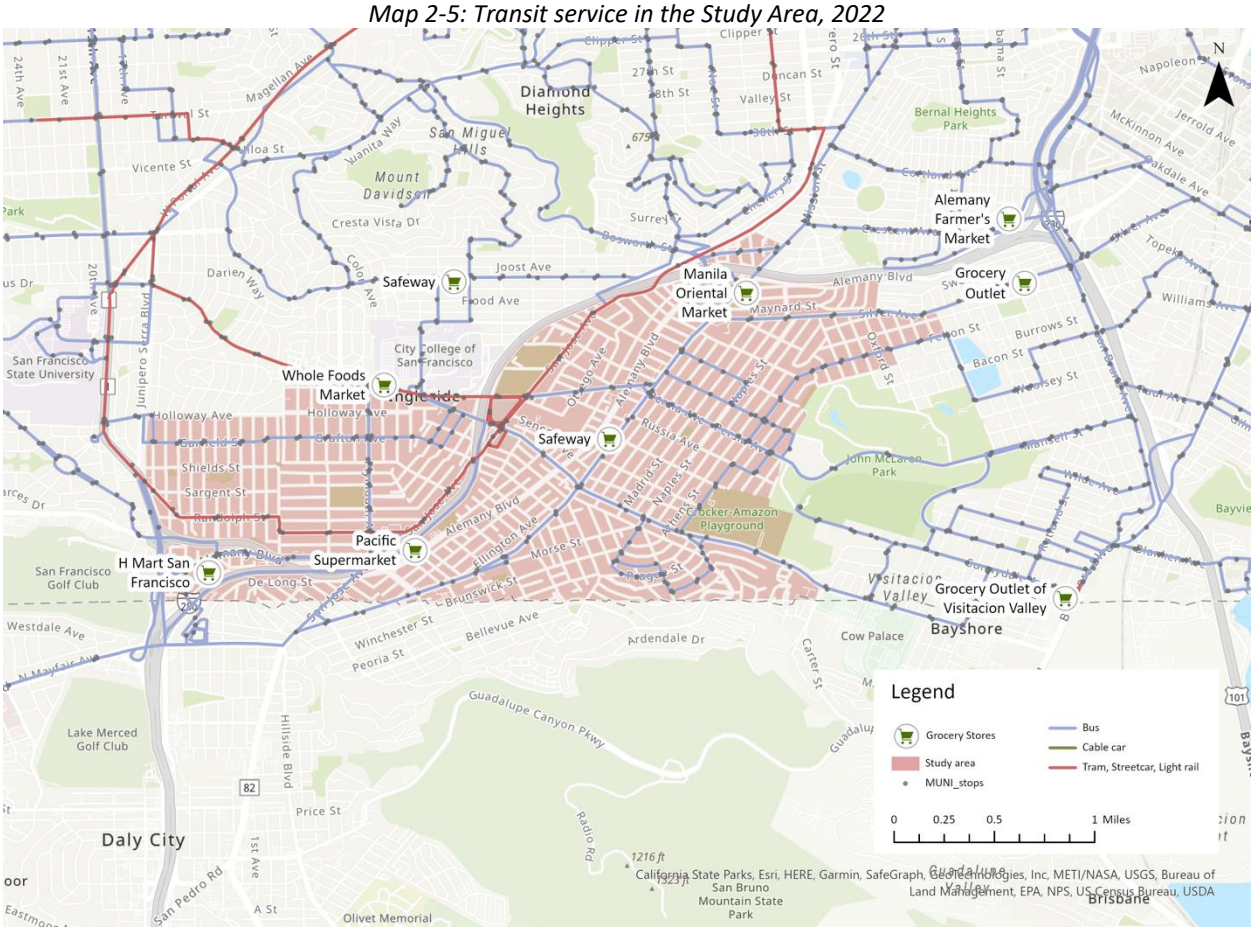
As it is now, many of these improvements have yet to be implemented, leaving pedestrians, bicyclists and transit riders unable to safely travel through the Excelsior/Outer Mission. Thus begs the question, given infrastructure and safety conditions, how accessible are the nearby grocery stores via walking, biking, or public transit?

2.3.2 Transit

Muni is the City's public transportation system. There are three light rail trains that pass through the Study Area: the M Ocean View, J Church, and K Ingleside. Map 2-5 shows the different bus and train lines in the Study Area. Service is above ground for all trains in this area. In addition to the trains, there are several bus lines that run through the Study Area. Bus 14R and Bus 9R are rapid buses which provide more streamlined service to downtown. Other notable buses are Bus 49 and Bus 14, which connect the Excelsior/Outer Mission to the Mission district and through downtown San Francisco. Bus 28 and Bus 29 provide service along the western side of the city through the Sunset and Richmond districts. Bus 28 terminates in the Marina district on the opposite side of the city. Several of the buses, including both Bus 28 and Bus 29 and all three trains, connect to the regional light rail service called Bay Area Rapid Transit (BART). There are three main BART stations near the Study Area; Daly City, Balboa Park, and Glen Park. BART provides speedy service throughout the city, with several stations downtown, and connects San Francisco to the rest of the Bay Area. BART service is partially underground in this area, but all tracks and stations are grade separated.

The abundance of service is vital to moving around the Excelsior/Outer Mission. Many residents depend on Muni for work trips, with 34% of residents commuting to work via public transportation (U.S Census, 2017). Public transportation can be particularly important for those who do not own or cannot afford a personal vehicle. It is important, therefore, that public transportation has good connections, quality stations, and safe on and off boarding to ensure that it can continue to be a viable option for those who rely on it.

Map 2-5: Transit service in the Study Area, 2022



Source: (Belov, 2020; DataSF | San Francisco Open Data, 2022)

SFMTA has made improvements to many Muni stops in recent years to improve safety and efficiency associated with on and off boarding. The abundance of service in the area is also helpful as riders with groceries may not want to travel long distances from home to the bus or the store to the bus. However, some stops remain inaccessible to many users. Figure 2-3 shows the Bus 28 stop at Junipero Serra Boulevard and Palmetto Avenue. This is the stop nearest to the H Mart. Going inbound, there is a shelter which provides weather protection, seating, and bus arrival times. This stop also serves Bus 54. The existence of the shelter reduces the chances of getting passed over, as this stop is not very busy. The sidewalk to this stop is narrow and uneven which could be a barrier for less able-bodied people. In the outbound direction, there is no shelter or any of the usual signage noting a bus stop. However, it is denoted as a stop on various Muni maps, including Google Maps, and drivers stop to let

people off there (Belov, 2020; Google Maps, n.d.). This is highly dangerous as the stop strands pedestrians on the side of a highway at edge of the city with very few pedestrian connections. The sidewalk abruptly stops in both directions with no connections to the opposite side of the street or the rest of the city. While this is a rare case, there are other stops in the Study Area that put riders in unsafe situations and can inhibit accessibility to grocery stores.

Figure 2-3: Cross-section of Junipero Serra Blvd. and Palmetto Ave and Bus 28 stops

Source: (Lee-Gardner, 2022)

3 Methodology

This chapter discusses the methodology used to evaluate grocery store access in the Study Area. Grocery stores are defined as stores where the primary goods are food related and must include a produce aisle. For this reason, liquor stores and corner stores were not included in this study. The accessibility of each store is first evaluated using a simplified gravity model that relies on travel time as a measurement of accessibility. Next, each store is evaluated to determine the level and quality of infrastructure around the store. The Excelsior/Outer Mission infrastructure scores for walking, biking, and transit are compared to scores in the Sunset neighborhood. The Sunset is a comparable neighborhood in terms of size and land use but has seen more infrastructure improvements and safety treatments over the past few years.

3.1 Location and travel time

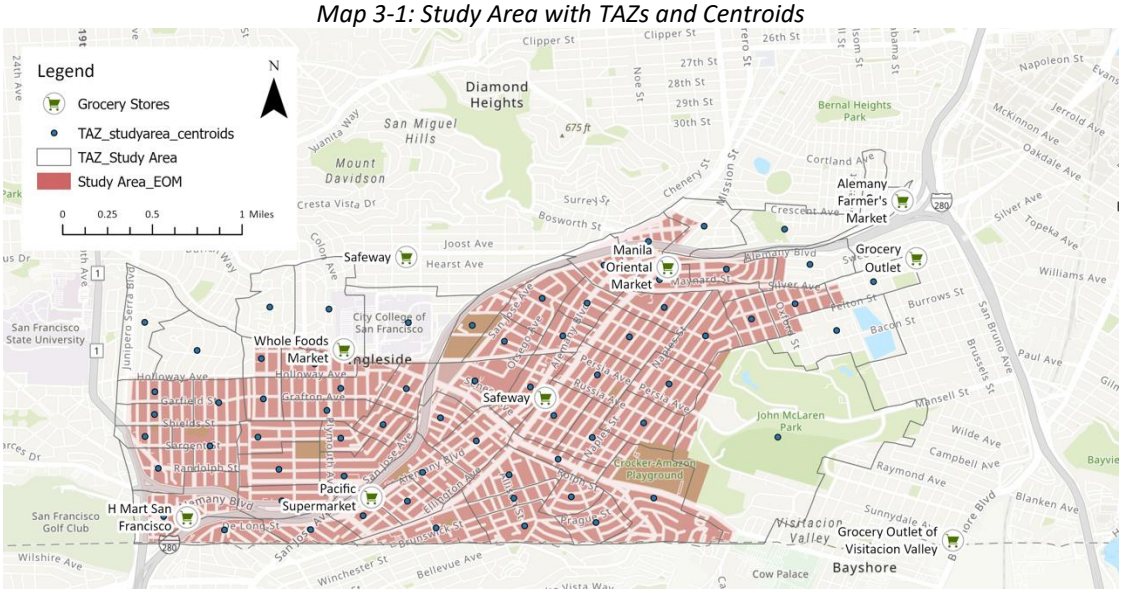
There are three main methods of measuring spatial accessibility: distance based, gravity based, and radiation based (Jiao & Azimian, 2021). Shimbel (1951) first introduced a distance based method of accessibility that calculated distances using links which was later adjusted to include an impedance factor (Ingram, 1971; Shimbel, 1951). However, distance is not comparable across modes and may not adequately reflect grocery store travel behaviors (Niedzielski, 2021; Widener, 2017). Alternatively, the gravity model predicts travel times on the network, resulting in an index that represents the intensity of attraction (Hansen, 1959; Jiao & Azimian, 2021; Niedzielski, 2021; Widener, 2017). The most recently developed model is the radiation model developed by Simini (2012). Radiation modeling uses a cost-decay function to determine the number of commuters to and from each zone (Jiao & Azimian, 2021). This model was proposed to allow more uniform calculations across larger geographic regions and time periods (Simini et al., 2012). As the Study Area and period of the study are relatively small, a simple gravity model is sufficient in measuring accessibility. Additionally, isochrones, or catchment areas, are

drawn up to illustrate another measure of accessibility, the number of opportunities (Chen, 2019; Niedzielski, 2021; Widener, 2017).

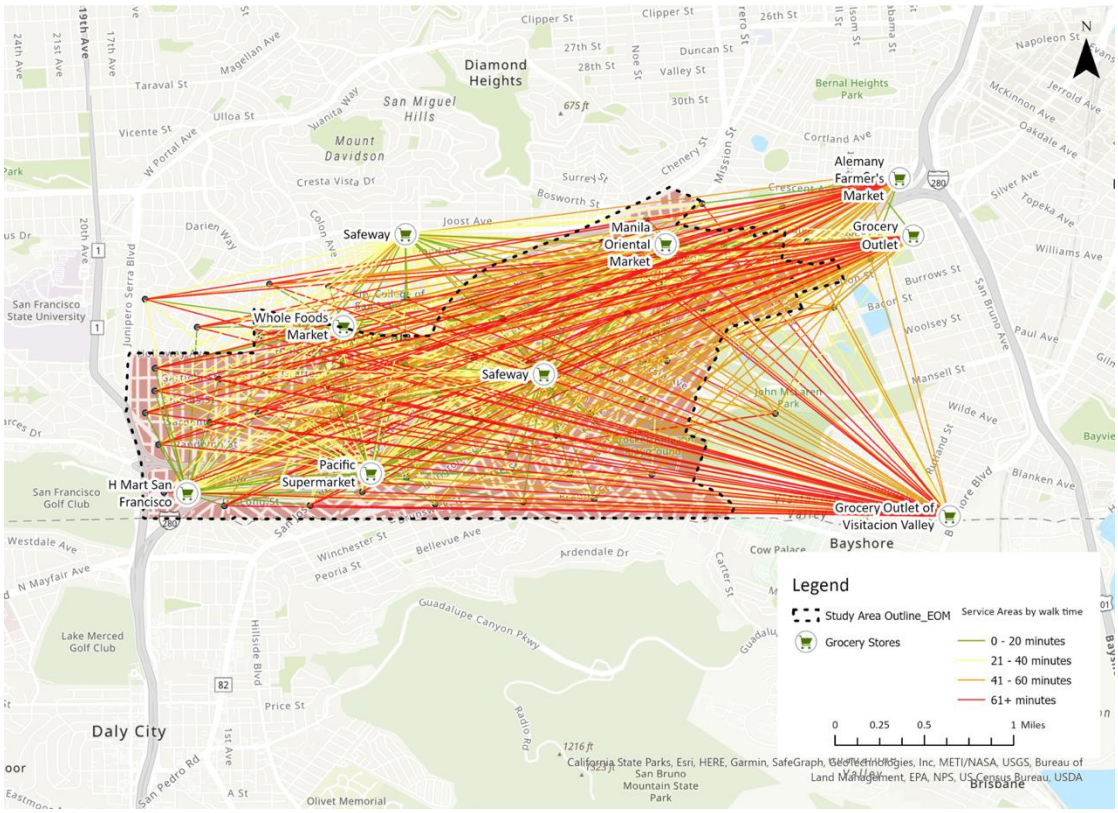
Travel time is an important measure of accessibility as it represents how quickly a person can reach a destination (Jiao & Azimian, 2021). Travel times were calculated using network data from the City of San Francisco from February and April 2022. As such, the results reflect travel conditions at that time, which may be unusual due to the ongoing COVID-19 pandemic. For example, some transit lines were working on adjusted schedules and select train lines (including the L Taraval line) were being served by buses. Additionally, some streets were designated as "Slow Streets", meaning they were closed to cars and opened to pedestrians and bicyclists to accommodate social distancing (City of San Francisco, 2022).

To calculate travel times from everywhere within the Study Area, the Excelsior/Outer Mission was divided into 67 Travel Analysis Zones (TAZs), as shown in Map 3-1. Then, using travel network data and ArcGIS Network Analyst tools, travel times were calculated from the center (centroid) of each TAZ to each of the stores. Map 3-2 shows all walk travel times to the stores; green lines have the shortest travel times (0-20 minutes), and dark red lines have the longest travel times (61+ minutes). Stores located more centrally have more green lines whereas stores located outside of the Study Area have fewer green lines and more yellow and red lines. Although lines are shown as direct connections from TAZ centroids to the stores, travel times are calculated by traveling along the network and accounts for closed streets (OD Cost Matrix Analysis Layer—ArcGIS Pro | Documentation, n.d.).

Map 3-1: Study Area with TAZs and Centroids



Map 3-2: Walk travel times in Excelsior/Outer Mission



Source: (DataSF | San Francisco Open Data, n.d.)

Transit travel times consider MUNI and BART scheduling to include wait times, in-vehicle time, and time walking to and from the stops. While pedestrian and transit travel times can be evaluated

directly, ArcGIS does not have a feature to consider travel time by bicycle. Instead, bike travel times are extrapolated from travel distances. This study used a 7 mph speed, which accounts for the terrain and the likely experience level of the riders going to the store (Dill & Gliebe, 2008; Chandler, 2021). Appendix 1 shows the travel time matrices by mode.

A gravity model was used to consolidate all the travel times from each centroid to each grocery store into one score for each store by mode. Gravity models balance the level of attraction of a destination with the impedance (travel time) of getting to that destination, revealing an index for accessibility (Geertman & Ritsema Van Eck, 1995; Hansen, 1959; Jiao & Azimian, 2021). The equation for a simplified gravity model is as follows.

$$GI_i = \sum {t_{ij}}^{-1}$$

$$\begin{gathered} \text{GI} = \text{Gravity Index} \\ \text{t} = \text{travel time} \\ \text{i} = \text{destination} \\ \text{j} = \text{origin} \end{gathered}$$

In the absence of travel diary data, it is assumed that gamma is negative one. Appendices 2 and 3 show individual gravity scores between each centroid and store for the Study Area and the Sunset as well as the sums of scores for each store. Because the gravity index is measuring attraction or access, a higher score reflects better travel time accessibility.

3.2 Quality of infrastructure

In addition to the traditional method of measuring accessibility, this study also measured the quality of infrastructure around the stores using a system of rating adapted from LA Metro's "Slow Speed Network Strategic Plan For the South Bay" (2017). The high crash rates and field work shows that the area around stores may be unsafe and inaccessible to pedestrians, bicyclists, and transit riders despite short travel times. Therefore, an analysis of infrastructure provides a supplementary measure of accessibility.

Grocery stores in the Excelsior/Outer Mission are located on two of three different street types (lee-Gardner, 2020). The street types and associated treatments are based on case studies (Lee-Gardner, 2020). The street types include main thoroughfares, neighborhood main streets, and neighborhood small streets.

Main thoroughfares are meant to provide connections throughout the city. These streets have high vehicle traffic levels and high speed limits, resulting in high pedestrian and bicycle collision rates, including many severe injuries and fatalities. These streets also have multiple lanes in each direction, large intersections, and serve at least one MUNI line. As such, main thoroughfares require complete street treatments. A list of elements to improve safety and usability of these street types for pedestrians, bicyclists, and transit riders based on case studies include the following:

- Biking
    - Bike boxes
    - Bike signals
    - Bike parking
    - Protected bike lanes
    - Striping through intersections
    - Wayfinding/signage
    - Dedicated turn lanes/turn restrictions
- Transit
    - Safe loading and unloading zones/stations
    - Well located stops/stations
    - Bus shelter
    - Bus only lanes

- Walking
    - Curb extensions/bulb-outs/painted safety zones
    - Wide sidewalks
    - Signalized intersections
    - Accessible pavement conditions
    - High visibility crosswalks
    - Improved corner sight distance (daylighting and stop bars)
    - Medians and pedestrian refuge islands
    - Midblock crossings
    - Pedestrian head starts

Neighborhood main streets are busy like main thoroughfares but serve a more local function. Rather than connecting to the wider city, these streets provide main access within the neighborhood. They have high pedestrian and bicycle levels and are located on or near MUNI lines. Vehicle traffic is still high, but speed limits are lower with typically one vehicle lane in each direction. Treatments to improve safety and use of neighborhood main streets include the following:

- Biking
    - Bike lane
    - Buffer for bike lane
    - Bike parking
    - Green painted lanes
- Transit
    - Safe loading and unloading zones/stations
    - Well located stops/stations

    - Bus shelters
- Walking
    - Curb extensions/bulbouts/painted safety zones
    - Chicanes, traffic calming
    - Wide sidewalks
    - Accessible pavement conditions
    - High visibility continental crosswalks
    - Improved corner sight distance (daylighting and stop bars)
    - Stop signs
    - Near slow street

Neighborhood small streets are largely residential. Although they are meant for local access only, they are often used as pass through streets. These streets have one lane in each direction and though less frequented than other street types, there is still a substantial number of pedestrians, bicyclists, and transit riders. Neighborhood greenways, which prioritize bike and pedestrian infrastructure over auto mobility are a good fit for these streets. The list of appropriate elements for neighborhood greenways include the following:

- Biking
    - Bike sharrows
    - Bike parking
    - Wayfinding/signage
- Transit
    - Safe loading and unloading zones/stations
    - Well located stops/stations

- Bus shelter

- Walking
  - Curb extensions/bulbouts/painted safety zones
  - Chicanes, traffic calming
  - Raised crosswalks (raised intersections)
  - Accessible pavement conditions
  - High visibility continental crosswalks
  - Improved corner sight distance (daylighting and stop bars)
  - Speed humps
  - Near slow street

Table 3-1 shows the breakdown of street types and appropriate street treatments for the streets that each store faces. Most of the stores in the Study Area are located on main thoroughfares. Due to the high speeds and high traffic levels, this street type poses the most danger to pedestrians, bicyclists, and transit riders. It is therefore especially important to have adequate improvements to ensure safety and comfort for non-motorized users.

Table 3-1: Street Types and Treatments for Grocery Stores in the Study Area

Store	Address	Street	Street type	Treatment type
1 Manila Oriental Market	4175 Mission St	Mission St.	Main Thoroughfares	Complete Street
2 Safeway	4950 Mission St	Mission St.	Main Thoroughfares	Complete Street
3 Whole Foods Market	1150 Ocean Ave	Ocean Ave.	Main Thoroughfares	Complete Street
4 H Mart San Francisco	3995 Alemany Blvd	Alemany Blvd.	Main Thoroughfares	Complete Street
5 Pacific Supermarket	2900 Alemany Blvd	Alemany Blvd.	Main Thoroughfares	Complete Street
6 Alemany Farmer's Market	100 Alemany Blvd	Alemany Blvd.	Main Thoroughfares	Complete Street
7 Grocery Outlet	1390 Silver Ave	Silver Ave.	Neighborhood Main Street	Neighborhoood Main Street
8 Grocery Outlet of Visitacion Va	2630 Bayshore Blvd	Bayshore Blvd.	Main Thoroughfares	Complete Street
9 Safeway	625 Monterey Blvd	Monterey Blvd.	Main Thoroughfares	Complete Street

Each store is evaluated to determine whether the appropriate infrastructure exists on the streets surrounding the store; a full list of scores can be seen in Appendix 4. Figure 3-1 shows how stores on neighborhood streets are graded. A point is given for each existing element, and overall scores

represent the ratio of elements that exist near a store over the total elements that make an ideal street for each street type. The scores range from one to five; as seen in Figure 3-1, stores that have less than 20% of the recommended elements are given a score of one, stores with 21% to 40% of elements are graded as two, and so on. The scoring focuses largely on the street that the store is facing, however the few blocks surrounding the store are also considered. Stores on neighborhood main streets and neighborhood small streets count their proximity to "Slow Streets" which provide extra separation for bicyclist and pedestrians. Though the scoring is primarily based on a binary—one point if the element exists, zero points if it does not, there are some instances where half points are awarded. If only one side of the block has any given element, then only a half point (0.5) is counted. This was particularly common for high visibility crosswalks, where one side of the block had them but not the other. On the other hand, a point and a half (1.5) are awarded for elements that are better than usual practice. For example, a point and a half are given when crosswalks are painted yellow or patterned to improve visibility or the street has painted bike lanes where only sharrows are required.

Scores are broken down into four categories: biking infrastructure, transit infrastructure, walking infrastructure, and infrastructure that ensures comfort and aesthetics. The biking infrastructure score counts the level of separation and protection from vehicles based on the street type. Other factors include bicycle amenities such as bike parking and wayfinding. Transit infrastructure focuses on proximity to stops, adequate shelters or stations, and whether the on- and off-boarding is safe. The walking infrastructure score includes safety measure at intersections to ensure pedestrians are seen and allowed time to cross. The score also includes measures to slow down vehicle speeds where appropriate or increase pedestrian separation. The "Accessible pavement conditions" accounts for the width and quality of the sidewalk to ensure that pedestrians of all abilities are able to use the infrastructure. Lastly, the comfort and aesthetics category focuses on the user experience on the street. For example, there is a measure for street trees which can provide shade, making it more bearable to walk or bike in hot

weather and parklets that can improve the street life, bringing a sense of safety to those using the street or sidewalk (Azad et al., 2021).

Figure 3-1: Example of infrastructure scoring for neighborhood streets

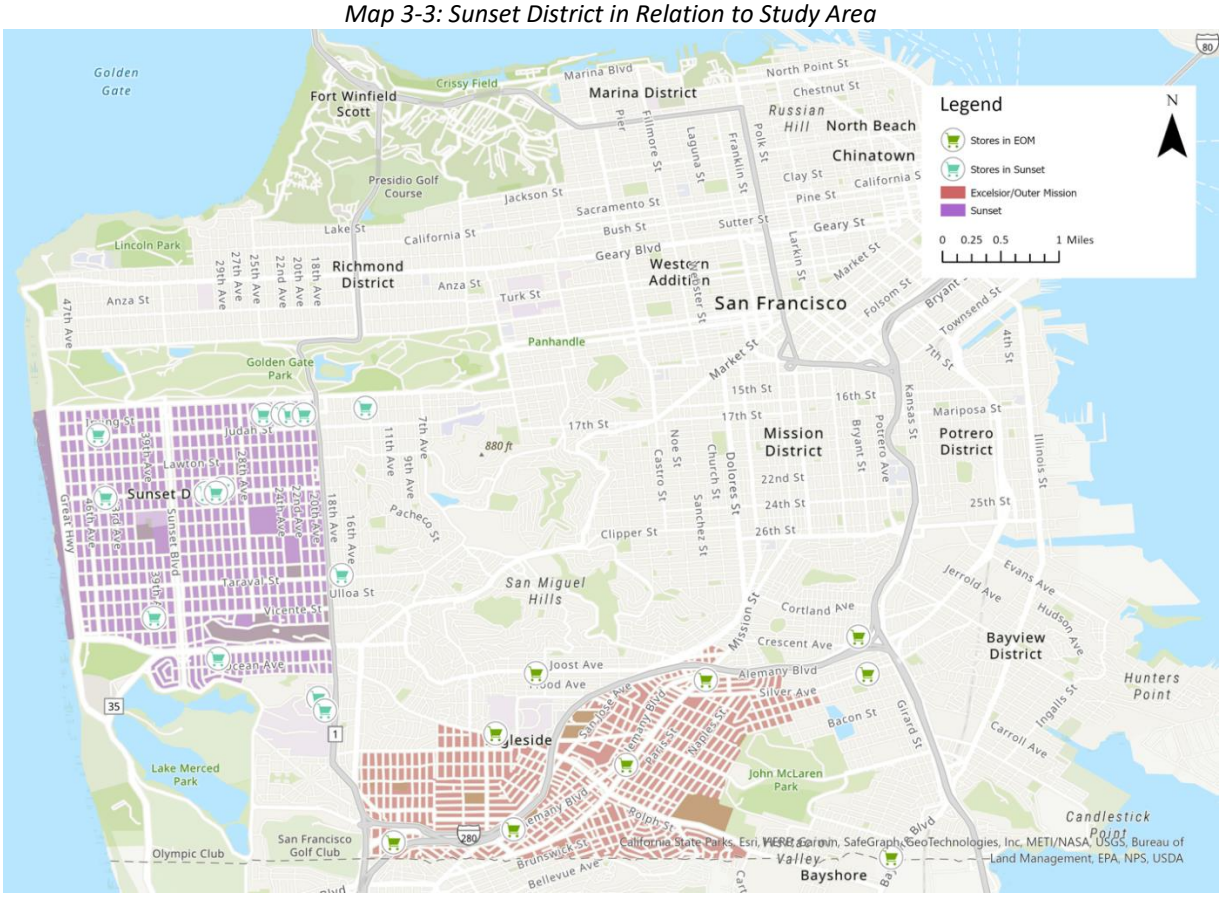
Neighborhood small street			Store		
Precedent Treatment Type		Precedent Elements	Count	Percent of elements	Score
Neighborhood small street: low vehicle traffic, high speeds but low speed limits, 1 lane per direction, used as cut throughs	Bike	Bike sharrows	1		
		Bike parking			
		Wayfinding/signage	1	**67%**	**4**
	Transit	Safe loading and unloading zones/stations	1		
		Well located stops/stations	1		
		Bus shelter	1	**100%**	**5**
	Pedestrian	Curb extensions/bulbouts/painted safety zones	1		
		Chicanes, traffic calming			
		Raised crosswalks (raised intersections)			
		Accessible pavement conditions	1		
		High visibility continental crosswalks	1		
		Improved corner sight distance (daylighting and stop bars)	1		
		Speed humps			
		Near slow street		**50%**	**3**
	Comfort and aesthetic	Parklets	1		
		Bioswales, landscaping			
		Street furniture	1		
		Tree coverage and sustainable landscaping	1	**75%**	**4**
Notes					

Scoring	
Score	Percent
1	1-20%
2	21-40%
3	41-60%
4	61-80%
5	81-100%

3.3 The Sunset District

The Sunset district of San Francisco is located slightly west of the Excelsior/Outer Mission. Map 3-3 shows the Sunset neighborhood (in purple) in relation to the Study Area (shown in red). This area is a good representation of a typical residential urban neighborhood in San Francisco and, as such, is a helpful base line for accessibility measurements in the city. The Sunset is similar to the Excelsior/Outer Mission in geographic location, size, and land use. Therefore, comparing accessibility scores in the Excelsior/Outer Mission to the Sunset, provides some context for the scores' values.

Map 3-3: Sunset District in Relation to Study Area



Source: (City of San Francisco, 2022)

The Sunset district has 16 stores within a mile of the neighborhood. That is nearly twice the number of stores that are in the Study Area. A large number of stores means residents have multiple options in terms of where they shop; this availability of store options is another valuable element of accessibility (Niedzielski, 2021). Additionally, more stores within the area likely means travel times to and from the stores will be smaller. Where many of the streets in the Excelsior/Outer Mission are located on main thoroughfares, many of the stores in the Sunset are on neighborhood main streets. Table 3-2 shows the street types and treatment types for the stores in the Sunset. Compared to main thoroughfares, neighborhood main streets present less danger to pedestrians, bicyclists, and transit riders as there is less traffic and speeds are generally slightly lower.

Table 3-2: Street Types and Treatments for Grocery Stores in the Sunset District

	Store	Address	Street	Street type	Treatment type
1	Sunset Super	2425 Irving St	Irving St.	Neighborhood Street	Neighborhood Greenway
2	S&B Supermarket	2203 Irving St	Irving St.	Neighborhood Main Street	Neighborhood Main Street
3	22nd and Irving Market	2101 Irving St	Irving St.	Neighborhood Main Street	Neighborhood Main Street
4	Sunrise Irving Market	1933 Irving St	Irving St.	Neighborhood Main Street	Neighborhood Main Street
5	Other Avenues	3930 Judah St	Judah St.	Neighborhood Street	Neighborhood Greenway
6	Gus's Community Market	3701 Noriega St Unit A	Noriega St.	Neighborhood Street	Neighborhood Greenway
7	Boss Supermarket	2551 Noriega St	Noriega St.	Neighborhood Main Street	Neighborhood Main Street
8	Noriega Food Market Inc	2444 Noriega St	Noriega St.	Neighborhood Main Street	Neighborhood Main Street
9	Superb Garden Grocery	2350 Noriega St	Noriega St.	Neighborhood Main Street	Neighborhood Main Street
10	Safeway	2433 Noriega St	Noriega St.	Neighborhood Main Street	Neighborhood Main Street
11	SM Supermarket	2801 Vicente St	Vicente St.	Neighborhood Street	Neighborhood Greenway
12	Lucky	1515 Sloat Blvd	Sloat Blvd.	Main Thoroughfares	Complete Street
13	Whole Foods	3251 20th Ave Suite 340	19th Ave.	Main Thoroughfares	Complete Street
14	Trader Joe's	265 Winston Dr	19th Ave.	Main Thoroughfares	Complete Street
15	Safeway	730 Taraval St	Taraval St.	Main Thoroughfares	Complete Street
16	Andronico's	1200 Irving St	Irving St.	Neighborhood Street	Neighborhood Greenway

4 Results

This section discusses the findings and results of the study. The results reveal how accessible the grocery stores in the Excelsior/Outer Mission are in comparison to a more typical residential neighborhood in San Francisco. As the study uses two methods for measuring accessibility, this section is separated into two subsections which discuss the travel times and quality of infrastructure as measures of accessibility. A third section refers to results of a composite accessibility score which combines the two components.

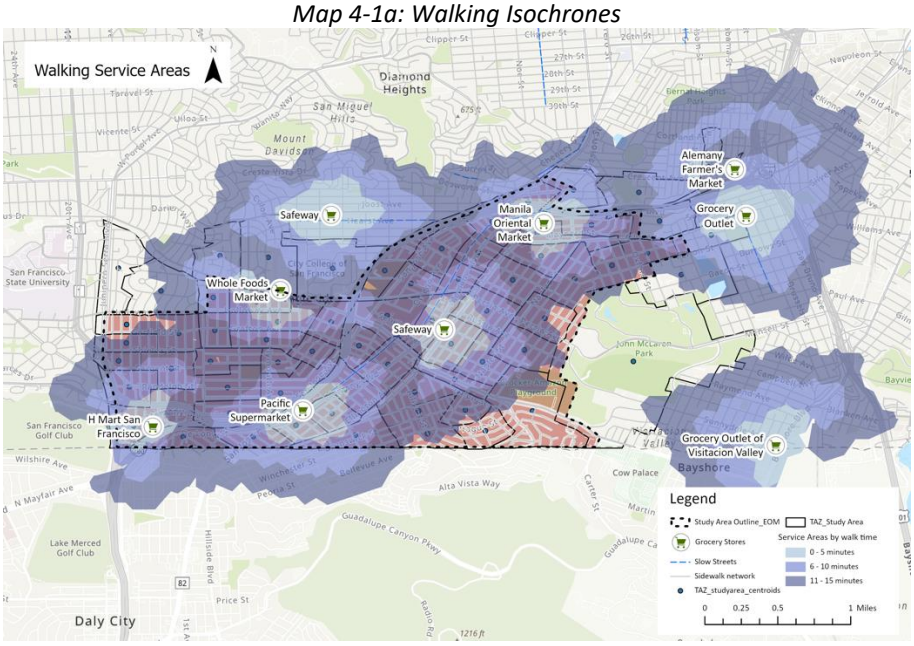
4.1 Location and travel time

4.1.1 Isochrones

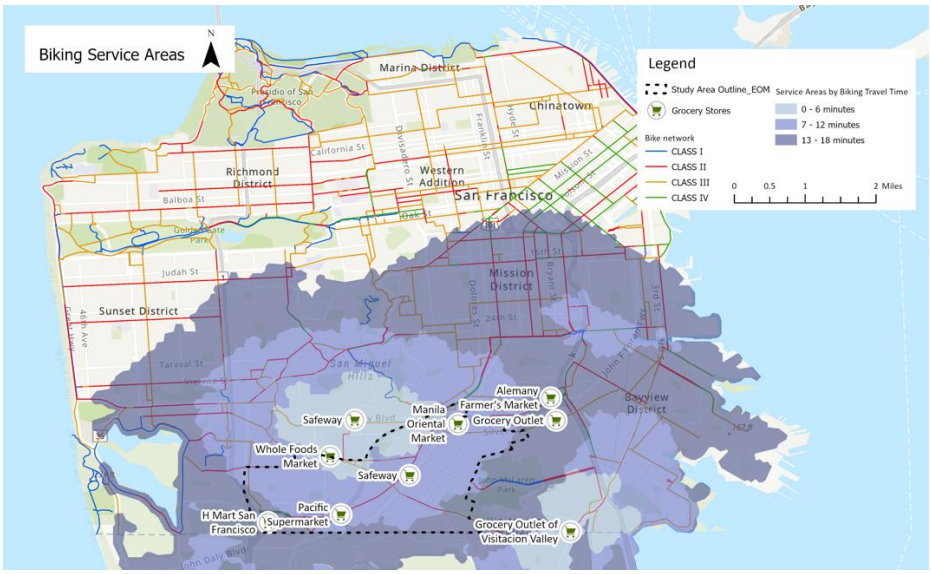
Isochrones show the extent to where a person can travel along the network given a certain time limit and mode. Maps 4-1a through 4-1f show isochrones, or the catchment areas where pedestrians, bicyclists, or transit riders respectively can reach various stores within three different time limits. For pedestrians, the cutoff times are 5, 10, and 15 minutes. As the walking speed is the slowest of the three modes, the catchment areas are smaller for this mode; and parts of eight of the 67 TAZs are not within the largest isochrone for walking. On the other hand, bicyclists have cutoff times of 6, 12, 18 minutes, as converted from distance, and can reach grocery stores in the Study Area from nearly everywhere in the southern half of the city.

Map 4-1: Isochrones for Stores in the Study Area

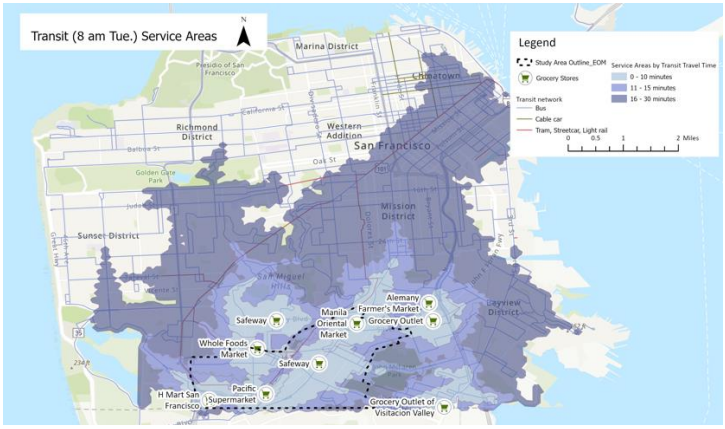
Map 4-1a: Walking Isochrones



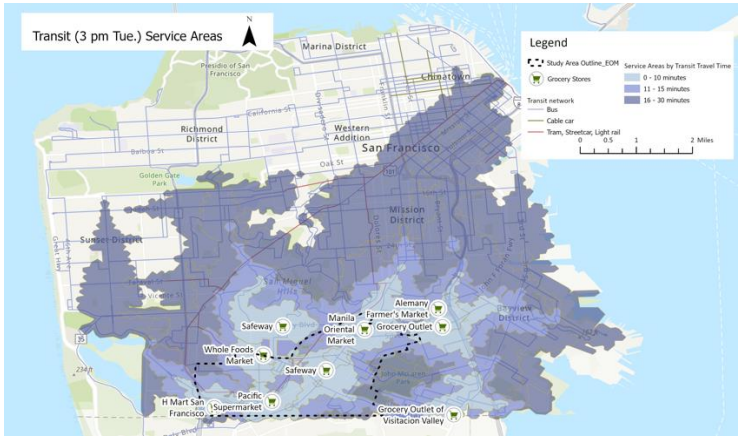
Map 4-1b: Biking Isochrones



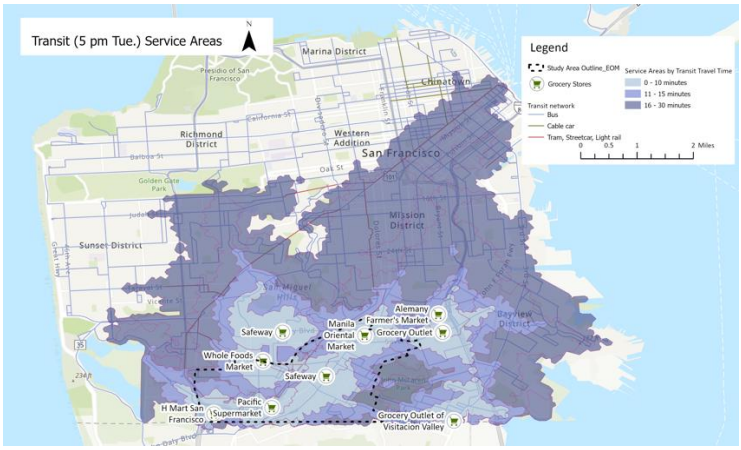
Map 4-c: Transit Isochrones - 8am Tuesday



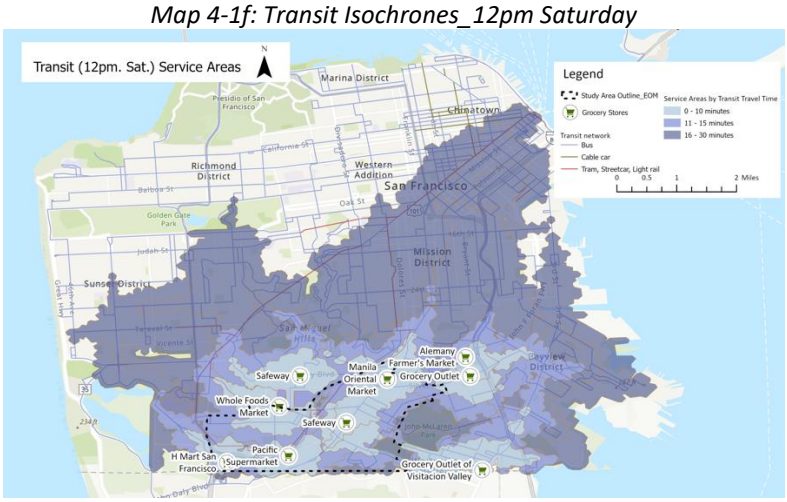
Map 4-1d: Transit Isochrones_3pm Tuesday



Map 4-1e: Transit Isochrones_5pm Tuesday



Map 4-1f: Transit Isochrones_12pm Saturday



Transit riders can go the furthest and have the longest cutoff times (10, 15, 30 minutes). As a result, transit riders can reach the stores from nearly anywhere in the city. Because the scheduling and frequency of buses or trains changes over the course of a day, travel times on transit change depending on the time of day. Therefore, the isochrones were generated at 8 am, 3pm, and 5pm on Tuesday to represent a typical day during rush hour and off-peak hour. To understand travel patterns on the weekend (where transit service is modified), isochrones were also generated for 12pm on Saturday. The catchment areas for transit stretch to the northeast portion of the city following the underground MUNI and BART lines which provide streamlined service throughout downtown. On the other hand, the northwest portion of the city has less transit service options and provides lower access from that side of the city.

While this study focuses on the stores within a mile of the Study Area, these maps show that people riding transit or biking can reasonably reach a number of stores outside of the Study Area. Given that people do not necessarily choose their primary store based on distance, but instead rely on other factors such as price, these maps exemplify the level of variety in choice and therefore accessibility for residents of the Excelsior/Outer Mission (McGuirt et al., 2018; Ploeg, 2015). Furthermore, these

isochrones also illustrate where people may be traveling from to reach the stores in the Excelsior/Outer Mission, portraying how accessible these stores are to other areas in the city.

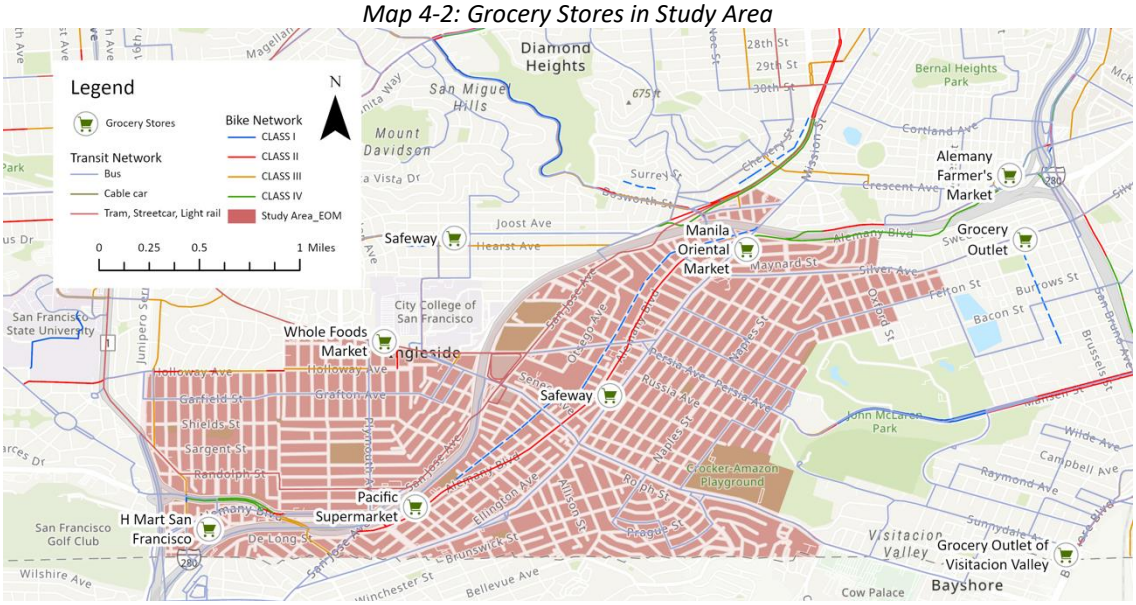
4.1.2 Gravity Index

In addition to the isochrone maps, individual travel times from each centroid to each of the stores provides a more in-depth comparative understanding of accessibility within the Study Area. Appendix 1 includes the travel times from each centroid to each store location. Travel times are converted to gravity indices using a gravity model, as discussed in the Methodology Section. The gravity indices represent relative accessibility in terms of travel time where higher index values indicate greater accessibility. Table 4-1 ranks the stores by gravity index and mode. Stores located more centrally in the Study Area have greater gravity indices, meaning they are more accessible. For example, the Safeway (store 2), located near the middle of the Study Area has the highest gravity score across all modes. For reference, Map 4-2 shows the store locations within the Study Area.

Table 4-1: Store Ranking by Gravity Index by Mode in Excelsior/Outer Mission

Store Ranking by Gravity Indices								
Walking			Biking			Riding Transit (8am)		
	Stores	Gravity Index		Stores	Gravity Index		Stores	Gravity Index
2	Safeway	4.1	2	Safeway	8.9	2	Safeway	5.4
3	Whole Foods Market	3.8	3	Whole Foods Market	8.4	5	Pacific Supermarket	4.4
5	Pacific Supermarket	3.7	5	Pacific Supermarket	7.4	3	Whole Foods Market	4.4
1	Manila Oriental Market	3.4	1	Manila Oriental Market	7.0	1	Manila Oriental Market	4.1
4	H Mart San Francisco	2.8	4	H Mart San Francisco	6.3	9	Safeway	3.3
9	Safeway	2.4	9	Safeway	5.3	4	H Mart San Francisco	3.2
7	Grocery Outlet	1.9	7	Grocery Outlet	4.1	7	Grocery Outlet	2.4
6	Alemany Farmer's Mark	1.8	6	Alemany Farmer's Mark	3.8	6	Alemany Farmer's Mark	2.1
8	Grocery Outlet of Visita	1.3	8	Grocery Outlet of Visita	2.7	8	Grocery Outlet of Visita	1.9

Map 4-2: Grocery Stores in Study Area



The stores are ranked in the same order for walking and biking travel times. Biking speeds are higher than walking speeds so the gravity indices are higher under the bike column than the walking indices, however, the ranking remains equal, as the location of the stores is constant.

The transit indices shown in Table 4-1 are based on 8am on Tuesday scheduling. Although the transit indices and store rankings are similar between peak hour, off-peak hour, and weekend schedules, there is some variation in the transit rankings compared to walking and biking. This is likely due to the geography of transit lines which may make some stores more difficult to reach compared to when walking or biking.

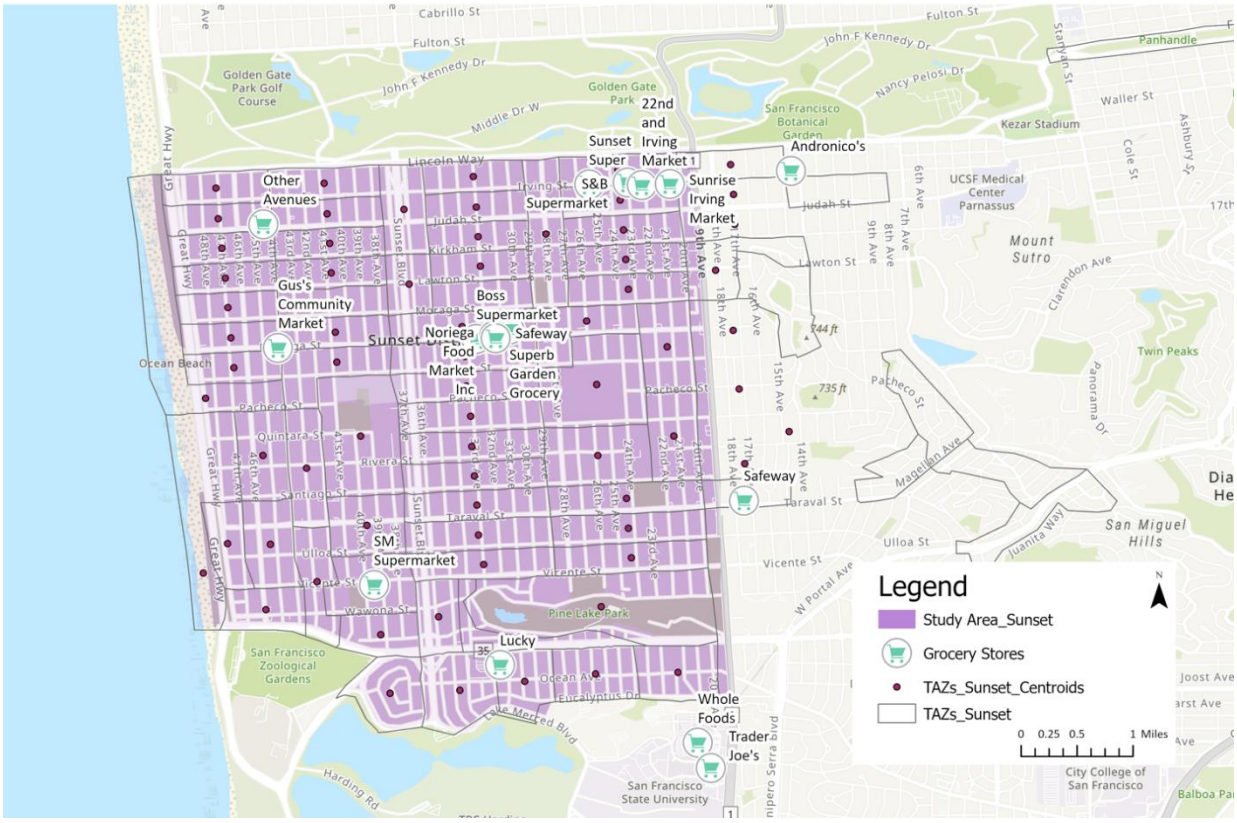
4.1.2.1 The Sunset

Gravity indices for the Sunset were also calculated for comparison. Although there are some higher gravity scores in the Sunset compared to the Study Area, most scores are relatively comparable. SM Supermarket (store 11) has a notably high score, particularly for bicyclists. This is because one centroid is located directly under this store so the impedance is significantly lower between that centroid, thus increasing overall accessibility.

Table 4-2: Store Ranking by Gravity Index by Mode in Sunset District

Store Ranking by Gravity Indices								
Walking			Biking			Riding Transit (8am)		
	Stores	Gravity Index		Stores	Gravity Index		Stores	Gravity Index
11	SM Supermarket	10.1	11	SM Supermarket	22.6	7	Boss Supermarket	5.9
7	Boss Supermarket	5.4	7	Boss Supermarket	12.1	11	SM Supermarket	5.9
8	Noriega Food Market In	4.9	8	Noriega Food Market In	10.9	2	S&B Supermarket	5.6
10	Safeway	4.8	10	Safeway	10.8	8	Noriega Food Market In	5.4
9	Superb Garden Grocery	4.5	9	Superb Garden Grocery	10.0	3	22nd and Irving Market	5.4
6	Gus's Community Mark	4.2	6	Gus's Community Mark	9.5	10	Safeway	5.3
2	S&B Supermarket	4.1	2	S&B Supermarket	9.1	9	Superb Garden Grocery	5.1
5	Sunset Super	3.9	5	Other Avenues	8.8	4	Sunrise Irving Market	5.1
1	Other Avenues	3.9	1	Sunset Super	8.8	1	Sunset Super	4.8
3	22nd and Irving Market	3.7	3	22nd and Irving Market	8.2	15	Safeway	4.8
15	Safeway	3.7	15	Safeway	8.1	5	Other Avenues	4.7
12	Lucky	3.6	4	Sunrise Irving Market	7.7	6	Gus's Community Mark	4.6
4	Whole Foods	3.5	12	Lucky	7.7	12	Lucky	4.3
16	Sunrise Irving Market	2.6	16	Whole Foods	5.8	13	Whole Foods	3.5
14	Andronico's	1.8	14	Andronico's	4.0	14	Trader Joe's	3.5
13	Trader Joe's	1.8	13	Trader Joe's	3.9	16	Andronico's	3.2

Map 4-3: Grocery Stores in the Sunset District



Stores in the Sunset are slightly more accessible than those in the Excelsior/Outer Mission as exhibited by higher gravity indices. Table 4-3 provides median gravity indices by mode for both areas. The differences in the median gravity indices for walking, biking, and transit are relatively similar.

Table 4-3: Comparison of Median Gravity Indices in Excelsior/Outer Mission with the Sunset District

Median Gravity Index by Mode			
	Excelsior/Outer Mission	Sunset	Difference (Sunset - Excelsior/Outer Mission)
Walk	2.8	3.9	1.1
Bike	6.3	8.8	2.6
Transit	3.3	4.9	1.6

Additionally, the sheer number of stores (16) in the Sunset provides more opportunity to choose the store that best meets a shopper's needs. This increase in opportunity itself indicates greater accessibility compared to the mere eight stores in the Excelsior/Outer Mission (Chen, 2019).

4.2 Quality of infrastructure

In addition to travel time, quality of infrastructure was also evaluated as an added measure of accessibility. The scores for quality of infrastructure are measured based on whether streets near the stores have adequate infrastructure to walk, bike, or ride transit safely. The Methodology Section discusses scoring in detail.

On average, scores for stores in the Excelsior/Outer Mission are low. The overall average score for stores in the Area is two out of five. Most notable is the extreme lack of bicycle infrastructure in this neighborhood, with an average infrastructure score of one. However, other scores are also low; the average score for transit infrastructure, pedestrian infrastructure, and comfort and aesthetics is three. Table 4-4 shows all of the scores by mode and store.

Table 4-4: Infrastructure Scores for Stores in the Excelsior/Outer Mission

Store	Bike score	Transit score	Pedestrian score	Comfort and aesthetic score	Average score
1 Manila Oriental Market	0	4	2	0	2
2 Safeway	0	3	3	3	2
3 Whole Foods Market	1	3	4	5	3
4 H Mart San Francisco	1	1	3	5	3
5 Pacific Supermarket	0	2	3	1	2
6 Alemany Farmer's Market	4	3	3	1	3
7 Grocery Outlet	1	4	3	3	3
8 Grocery Outlet of Visitacion Va	1	4	3	3	3
9 Safeway	1	2	4	3	3
Average score	1	3	3	3	2

Comparable scores from the stores in the Sunset can provide context to help understand whether these scores are on par with the rest of the city or are unusually low. As seen in Table 4-5, the scores of the Sunset are relatively higher, with an average score of four out of five. While most stores in the Excelsior/Outer Mission have bike scores of one, nearly all of the bike scores in the Sunset are two or higher. Transit scores are generally remarkably high in the Sunset—mostly fives with a few fours, as most stores are on streets or near streets with bus or train access and proper stops and stations. Where there are only two stores in the Excelsior/Outer Mission that have pedestrian scores of four, ten out of the sixteen stores in the Sunset have a pedestrian score of four. The comfort and aesthetics score is the most varied of the categories in the Excelsior/Outer Mission, with scores ranging from zero to five. In the Sunset, the lowest comfort and aesthetics score is three and the most common score is four.

Table 4-5: Infrastructure Scores for Stores in the Sunset

Store	Bike score	Transit score	Pedestrian score	Comfort and aesthetic score	Average score
1 Sunset Super	2	5	3	4	4
2 S&B Supermarket	1	4	5	3	3
3 22nd and Irving Market	2	5	5	4	4
4 Sunrise Irving Market	3	5	5	4	4
5 Other Avenues	2	5	3	5	4
6 Gus's Community Market	2	5	4	5	4
7 Boss Supermarket	0	4	4	3	3
8 Noriega Food Market Inc	2	4	4	4	4
9 Superb Garden Grocery	2	4	4	4	4
10 Safeway	2	4	4	3	3
11 SM Supermarket	5	5	4	4	5
12 Lucky*	3	4	3	3	3
	1	4	4	3	
13 Whole Foods	2	5	4	4	4
14 Trader Joe's	2	5	4	4	4
15 Safeway	0	4	4	4	3
16 Andronico's	2	5	3	3	3
Average score	2	5	4	4	4

**The Lucky store has two entrances that open out to two different streets, so there are two scores per category for this store.*

In comparing scores with the Sunset, it is visible that the infrastructure scores of the Excelsior/Outer Mission are relatively lower. It follows that the infrastructure and thus the accessibility to grocery stores in the Excelsior/Outer Mission is lower. This highlights a need for better infrastructure in the Study Area.

4.3 Composite Accessibility

The composite score combines travel time and travel infrastructure measurements into one score. First, gravity scores are rescaled to the highest score in the Sunset, which represents ideal conditions. The scores are then normalized on a 0-5 range to match the infrastructure scores. Due to the wide range of gravity scores, the scores are normalized by mode. Below is the formula for normalizing gravity indices:

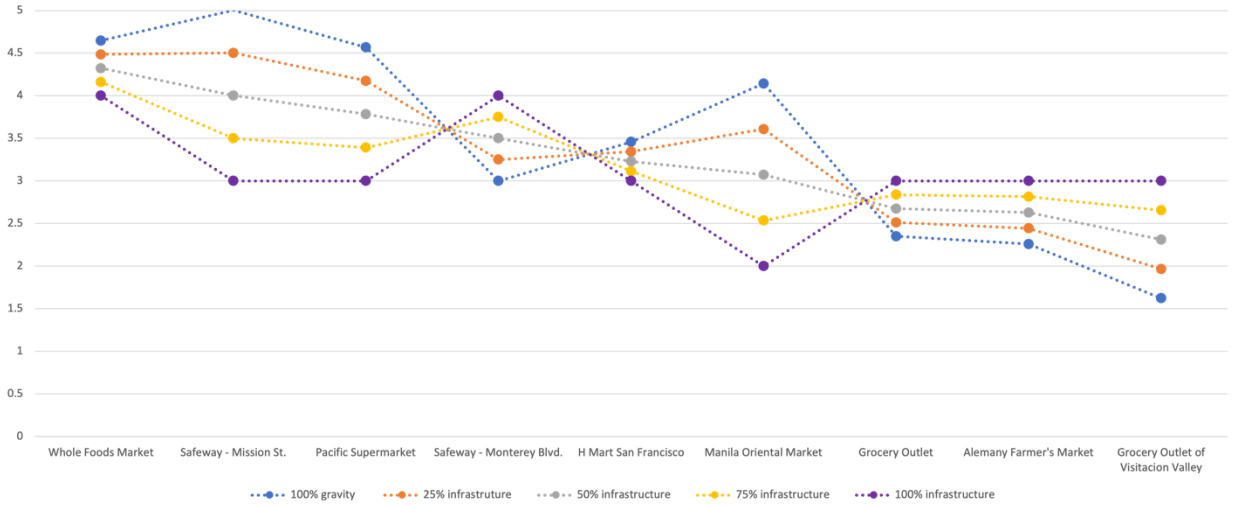
$$GI_{normalized} = \left(\frac{GI_{original}}{\max Sunset\ GI}\right) * 5$$

Once normalized, the two scores can be combined. Appendix 5 includes all the scores at different weights for the two components (gravity score and infrastructure score) by mode and Figures 4-1 through 4-3 graphically show the composite scores at different weights by mode. The blue line represents accessibility scores where 100% of the weight is on the gravity indices, the orange line shows accessibility scores where infrastructure is weighted at 25%, the gray line weights gravity indices and infrastructure at 50% equally, the yellow line puts more weight (75%) on infrastructure, and the purple line shows accessibility scores where 100% of the weight is on the infrastructure scores. The stores are ranked by accessibility score weighted at 50% infrastructure with highest scores on the left and lowest scores on the right in each graph. By weighting the scores differently, these charts illustrate the sensitivity to infrastructure and travel time.

4.3.1 *Walking*

Figure 4-1 shows the sensitivity of accessibility for walking. Disparity in accessibility is relatively consistent across all stores, as represented by the relatively equal spaces between the different lines. Additionally, giving more weight to infrastructure increases accessibility across all stores. This is likely because infrastructure scores for the Study Area are relatively average (mostly three out of five), whereas gravity indices normalized to the Sunset are lower due to an outlier in the Sunset gravity model. The yellow, gray, and orange lines in the figure show that improving infrastructure conditions can improve accessibility for this area. Implementing more pedestrian safety elements as suggested by the infrastructure scoring system can improve accessibility at stores like the Safeway on Mission St. and the Manilla Oriental Market that have some of the highest proximity scores but low infrastructure scores for walking.

Figure 4-1: Sensitivity of Accessibility by Walking

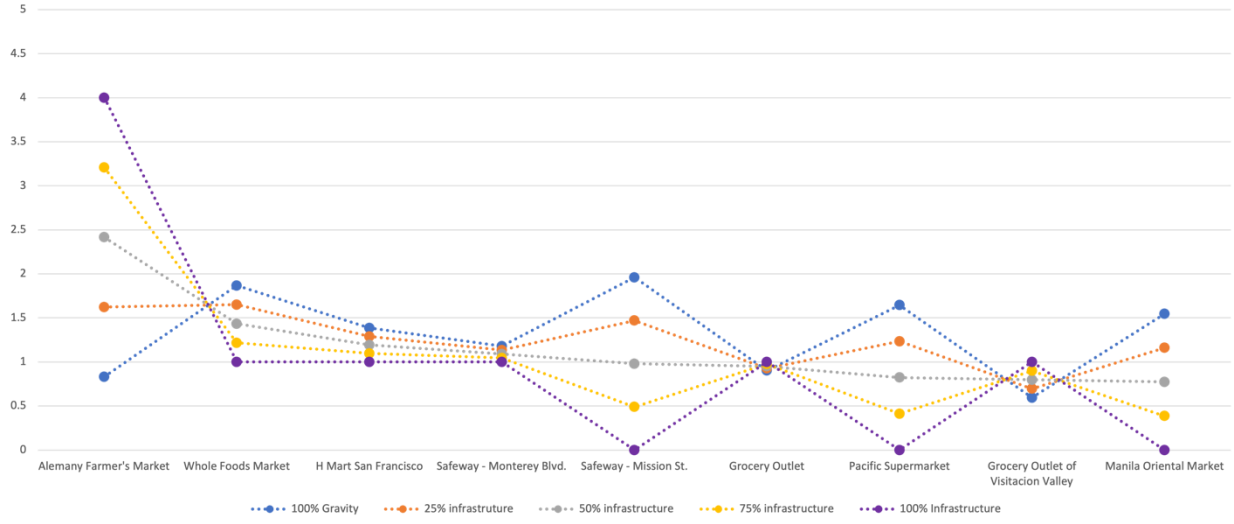


4.3.2 *Biking*

Accessibility by biking varies wildly by store, as seen in Figure 4-2. The Alemany Farmers' Market has a protected bike lane and other bike amenities, thus boosting the infrastructure score to 4. However, the gravity index is one of the lowest, as the market is on the outskirts of the Study Area. On

the other hand, the Safeway on Mission St. is centrally located and has the highest gravity index but no bicycle infrastructure, thus yielding an infrastructure score of zero. In general for biking, tending toward gravity alone increases accessibility, while tending to infrastructure alone decreases the level of accessibility for biking. This variation in sensitivity emphasizes the importance of considering both factors when evaluating accessibility. Moreover, stores with a large disparity in proximity and infrastructure conditions should be prioritized for infrastructure improvements as there is a potential for these locations to become highly accessible.

Figure 4-2: Sensitivity of Accessibility by Biking

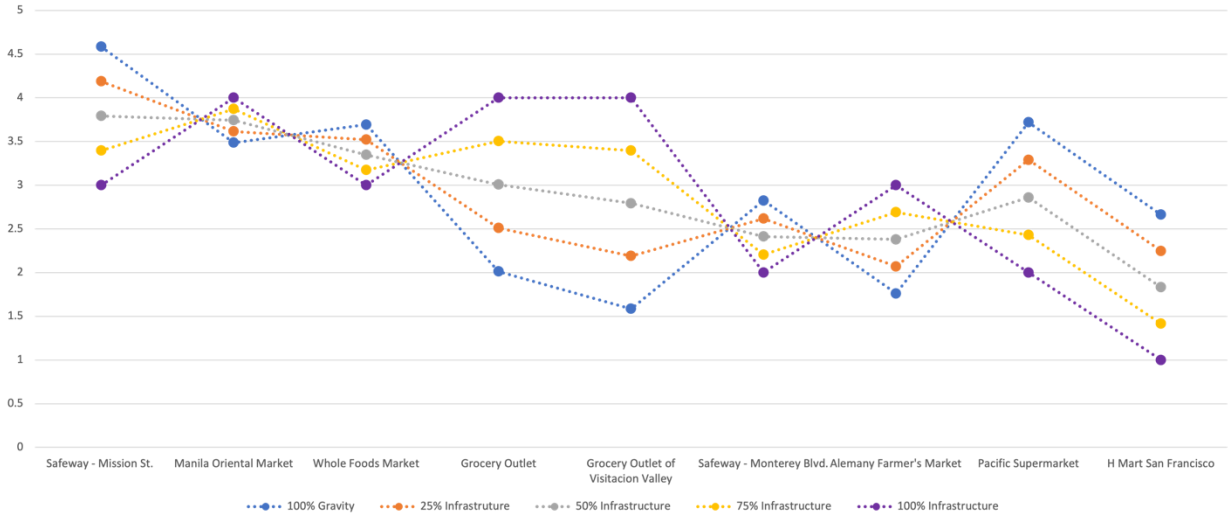


4.3.3 Riding transit

Unlike walking and biking, there is less consistency in which factor has a higher score for riding transit. Five out of the nine store have higher gravity indices and lower infrastructure scores. Pacific Supermarket is particularly notable, as there is a large disparity between the location, denoted by the gravity index, and the quality of infrastructure, represented by the infrastructure score. On the other hand, there are four stores where the infrastructure score is higher than the gravity score. The Grocery Outlet of Visitacion Valley has good transit infrastructure but is the farthest store from the Study Area.

Compared to the sensitivity graphs for walking and biking, Figure 4-3 shows the largest disparities between 100% gravity and 100% infrastructure scores. This indicates high sensitivity.

Figure 4-3: Sensitivity of Accessibility by Riding Transit



5 Discussion

This section provides insight into the results of the study and relates findings to the transportation planning/engineering field at large. It also includes implications of this study, policy recommendations, and areas for further research.

The findings highlight a lack of accessibility in the Excelsior/Outer Mission compared to other similar neighborhoods. This is illustrated by the gravity model which results in slightly lower indices for stores in the Excelsior/Outer Mission. Furthermore, there are fewer opportunities to reach stores in the Study Area than in the Sunset. While it appears from gravity indices that stores in the Excelsior/Outer Mission are only slightly less accessible, infrastructure scores indicate significantly lower levels of accessibility by travel infrastructure.

The gravity model shows that stores are more accessible by bicycling and riding transit than walking. This is likely because travel times are longer when walking than when biking or riding transit. However, contrary to the gravity model, where bicycle gravity scores are high, the infrastructure scores for bicycling are exceptionally low (with an average of one), highlighting a lack of adequate bicycle infrastructure. In general, given the low bicycle infrastructure scores, the sensitivity of accessibility graph for biking demonstrates that accessibility it sensitive to infrastructure and overall accessibility decreases as more weight is given to infrastructure. However, gravity indices show that spatially stores are relatively accessible, so it is likely that improved infrastructure across all modes would greatly increase accessibility for those using alternative modes.

Additionally, the gravity model demonstrates the importance of land use in increasing travel time accessibility. The Sunset has some extremely high gravity indices because some centroids are exceptionally close to stores. This reflects the mixed use land use conditions in the Sunset. On the

contrary, in the Excelsior/Outer Mission there is more separation between stores and housing areas, which contributes to the higher travel times and lower gravity scores.

The composite accessibility scores and associated sensitivity analysis further underlines the importance of considering the two components of proximity and infrastructure. The sensitivity analysis shows that infrastructure can have a large effect on overall accessibility. Specifically in the Excelsior/Outer Mission neighborhood, with its rather low infrastructure scores, the higher the weight attributed to the importance of infrastructure the lower is composite accessibility. Not only does this highlight the importance of including infrastructure measures, but it provides a framework for future infrastructure improvements. Stores with large disparities between gravity and infrastructure scores should be prioritized for improvements as there is potential for these locations to become highly accessible.

Rather than measuring accessibility using only travel time via a gravity model or other spatial model, this study shows the importance of combining the location proximity model and infrastructure information to provide a more complete picture. This is particularly important for those walking, biking, or riding transit where safety is a greater consideration. Given the context of high collision rates and high walking, biking, and transit ridership levels in the Study Area, it is important that the definition of accessibility includes infrastructure to represent how people walking, biking, and riding transit navigate the network to reach their destinations (City of San Francisco, 2015; San Francisco Planning Department, 2020). This study provides one such way to include the unique considerations of pedestrians, bicyclists, and transit riders by including an infrastructure scoring system. Together, the two components of physical proximity and availability of infrastructure work together to highlight areas of priority for improving access.

5.1 Policy implications

The results of this study, particularly the ranking of gravity indices and sensitivity analysis, provide a framework for how to prioritize infrastructure improvements to the conditions the infrastructure scoring system depicts. At the local level, the City should prioritize improving infrastructure at stores that are easy to reach in terms of travel time. The infrastructure scoring provides details on the features and characteristics that are available or missing in reaching each store. Additionally, the City should further prioritize bicycle infrastructure as there is a mismatch between the relatively high bicycle gravity index scores and the relatively low bicycle infrastructure scores. In terms of the gravity indices, the City should consider land use adjustments, such as favoring more mixed use development to increase proximity to stores and decrease travel times.

On a larger scale, this study highlights the need to redefine accessibility to become more inclusive of all modes and relative components. Important data sources such as the Healthy Places Index still rely solely on distance to measure accessibility. Given that sensitivity analysis shows that infrastructure can have a considerable effect on accessibility, it is important that widely used data sources such as the Healthy Places Index update their methodology to adequately measure grocery store accessibility for all users.

While the scope of this study is somewhat narrow, implications about measuring accessibility can extend beyond grocery store access. The procedure presented in this study is applicable to the study of accessibility to health centers, public facilities, parks, education centers and so on. The assessment of accessibility to these other amenities and facilities could similarly include infrastructure considerations for pedestrians, bicyclists, and transit riders. Additionally, while this study is within an urban setting, the methods used can apply to suburban areas as well. Gravity modeling is already well used in suburban areas and the infrastructure methodology is adaptable to other areas with a few adjustments to the infrastructure scoring criteria to include appropriate street types for the area.

5.2 Future research

In terms of future research, this study takes a simple approach by just evaluating the area around the stores, however, future research could incorporate other measures, like level of stress on links surrounding the stores as a component in the infrastructure scoring system to better understand the grocery shoppers' perceptions of safety and further incorporate network connectivity considerations. Additionally, the infrastructure scoring system can be improved by adding an overall walkability component to the transit category, as walking is included in almost all transit trips. Although walking was considered in the gravity model for transit, walking was not explicitly integrated into the transit infrastructure scoring system in this study due to scope. However incorporating this concept in future research could provide more detailed results.

Supplemental research on understanding how quality of infrastructure affects travel behavior and perceptions of accessibility would further bolster this area of analysis. In this study, the proposed modification to measuring accessibility includes scoring of proximity and scoring of infrastructure quality. A third potential component could be scoring of operating conditions (e.g. by taking inspiration from PLTS and BLTS methodology) for inclusion in a further refinement of how to measure "accessibility". Lastly, future researchers should collect travel diary data to calibrate the gravity model and add weighting to the infrastructure scoring system to provide more refined means of scoring the components.

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Appendix

Appendix 1: Travel times by mode in Study Area

Walking Travel Time										
	Grocery Stores									
Centroids	1	2	3	4	5	6	7	8	9	Grand Tota
1	23.56	39.62	53.64	76.08	58.84	3.79	15.52	47.52	42.51	361.08
2	14.07	30.94	45.63	68.69	50.16	12.14	23.38	50.31	34.81	330.14
3	7.01	23.07	37.75	60.82	42.29	19.10	24.12	52.29	26.93	293.37
4	5.71	22.59	37.12	60.13	41.81	19.88	20.28	48.45	31.91	287.89
5	14.90	29.12	43.65	66.65	48.34	22.04	12.98	37.23	41.99	316.89
6	12.49	25.65	40.43	62.63	45.12	26.71	17.84	40.19	35.38	306.44
7	3.72	16.39	30.93	53.93	35.61	25.77	23.92	50.89	25.79	266.94
8	20.92	35.13	49.67	72.67	54.36	17.98	5.86	36.97	47.43	340.99
9	14.37	30.59	45.12	68.13	49.81	19.87	11.22	43.38	39.83	322.31
10	24.04	35.80	50.42	72.67	55.11	28.02	15.90	35.71	46.15	363.82
11	47.36	37.01	54.16	69.89	52.55	51.90	39.70	24.74	58.42	435.74
12	11.22	20.61	35.22	57.62	39.91	29.87	21.56	43.99	30.61	290.62
13	16.99	14.63	30.32	51.62	34.23	35.86	27.56	34.43	32.05	277.68
14	21.61	10.11	28.57	47.01	29.66	40.48	32.18	32.32	34.17	276.11
15	22.41	7.26	25.76	42.43	24.11	41.68	37.77	36.02	35.88	273.31
16	19.75	2.98	22.06	38.72	20.40	43.76	40.47	40.26	30.30	258.71
17	15.09	6.48	23.63	44.39	26.08	39.10	33.90	39.21	26.30	254.17
18	9.99	12.13	26.71	49.72	31.40	32.03	28.21	41.62	27.45	259.25
19	5.54	16.58	31.16	54.17	35.85	27.58	23.76	48.96	26.54	270.14
20	35.13	19.13	32.37	44.88	27.54	53.78	44.94	37.40	42.48	337.65
21	33.46	17.36	30.48	41.08	23.92	52.71	44.93	38.61	40.60	323.16
22	30.71	14.61	27.74	38.13	20.79	49.96	42.41	38.45	37.85	300.65
23	25.04	8.94	22.19	38.59	20.27	45.81	41.90	38.90	32.30	273.95
24	27.41	9.44	22.53	33.50	15.17	51.43	48.50	45.19	32.65	285.83
25	30.04	12.07	25.03	32.13	14.79	54.05	48.30	44.64	35.15	296.21
26	33.14	15.17	28.13	34.79	17.63	57.15	49.96	44.73	38.25	318.96
27	35.96	17.99	27.78	25.26	7.92	59.97	56.19	52.22	39.90	323.19
28	31.79	14.12	21.08	23.84	5.51	55.81	52.88	53.44	31.94	290.42
29	34.72	17.05	23.99	22.10	4.12	58.73	55.80	54.31	35.69	306.51
30	39.56	21.89	21.70	17.80	3.32	63.58	60.65	58.04	37.36	323.90
31	43.37	25.77	21.10	13.26	6.81	68.14	64.46	63.34	36.76	343.01
32	51.81	34.21	29.54	15.73	15.24	76.58	72.90	71.77	45.20	412.97
33	19.14	5.98	18.91	37.73	19.42	43.15	40.22	43.93	25.89	254.37
34	26.03	8.44	18.26	29.48	11.16	50.05	47.12	47.77	28.38	266.68
35	28.62	12.36	13.43	29.72	13.73	52.43	49.70	51.69	23.54	275.22
36	25.14	8.92	12.85	33.06	16.93	48.91	46.23	48.30	22.97	263.31
37	9.03	23.41	33.53	57.01	40.91	24.64	29.84	58.01	22.72	299.10
38	7.27	17.57	28.55	50.98	33.96	30.41	30.18	56.35	20.30	275.57
39	9.66	12.17	24.40	47.41	29.09	32.79	30.92	49.00	20.49	255.93
40	13.81	8.52	20.19	42.75	25.32	37.24	34.89	45.36	19.73	247.80
41	19.84	10.32	15.13	37.69	24.22	43.36	40.92	48.27	19.13	258.88
42	14.60	14.52	22.15	44.59	30.45	37.05	35.81	51.35	16.73	267.24
43	23.22	15.84	15.85	39.12	25.66	44.33	44.49	53.15	13.53	275.19
44	38.42	24.07	11.52	20.96	12.80	62.16	59.50	63.40	25.39	318.22
45	40.54	22.95	17.32	18.27	9.87	63.85	61.63	62.28	32.98	329.69
46	45.90	28.30	21.55	9.61	9.18	69.20	66.98	65.76	37.21	353.70
47	44.25	27.57	18.28	13.01	12.89	68.00	65.34	66.90	33.94	350.18
48	45.50	31.16	16.77	14.11	17.69	69.25	66.59	70.49	30.68	362.23
49	29.91	16.18	8.34	29.62	16.96	53.66	51.00	55.56	18.46	279.69
50	34.05	19.71	10.96	25.61	13.08	57.80	55.14	59.04	22.45	297.85
51	37.83	24.68	7.57	23.12	14.96	61.58	58.92	64.01	23.98	316.65
52	35.70	22.98	4.15	26.57	18.33	59.83	56.78	62.31	20.57	307.21
53	36.78	25.52	4.28	26.90	20.95	60.65	57.86	63.76	18.03	314.74
54	42.81	31.55	10.31	22.23	26.63	66.68	63.89	69.79	23.02	356.92
55	42.03	28.89	11.73	18.84	21.65	65.78	63.12	68.22	25.46	345.71
56	35.29	26.97	5.73	32.14	26.11	55.52	56.81	65.21	11.65	315.44
57	42.32	31.06	9.81	28.14	30.44	66.19	63.40	69.30	21.90	362.55
58	27.48	22.76	8.63	37.75	26.85	48.58	48.99	62.14	9.81	293.00
59	47.70	36.44	15.19	19.87	32.66	71.57	68.78	74.68	26.19	393.07
60	52.16	40.90	19.66	25.94	39.39	72.32	73.25	79.14	27.17	429.94
61	45.90	32.75	15.60	15.00	25.51	69.64	66.98	72.08	28.70	372.16
62	51.43	36.22	21.13	9.46	21.02	75.18	72.52	75.55	34.24	396.75
63	56.57	38.98	31.65	2.81	19.75	79.87	77.66	76.28	44.63	428.20
64	54.88	38.20	28.08	8.42	22.17	78.62	75.96	77.53	41.03	424.88
65	55.61	41.77	25.31	11.99	25.74	79.36	76.70	81.10	38.40	435.99
66	52.35	39.21	22.05	13.91	27.66	76.10	73.44	78.54	35.14	418.39
67	51.54	38.80	19.99	16.35	30.10	75.67	72.63	78.13	32.71	415.94
Grand Tota	2006.18	1510.13	1634.46	2419.25	1751.91	3336.68	3124.14	3639.93	2057.73	21480.41

Biking Travel Time										
	Grocery Stores									
Centroids	1	2	3	4	5	6	7	8	9	Grand Tota
1	10.46	17.58	23.61	34.12	26.11	2.62	7.60	21.96	19.35	163.40
2	7.28	14.41	20.43	30.94	22.94	5.33	10.32	24.67	16.20	152.53
3	3.11	10.24	16.26	26.77	18.77	8.48	13.46	27.82	12.03	136.94
4	3.41	10.03	16.48	26.56	18.56	8.63	9.37	26.28	14.38	133.70
5	7.49	12.92	19.37	29.46	21.45	10.84	6.19	21.46	18.46	147.65
6	6.45	11.38	17.87	27.95	19.95	12.92	8.35	19.49	17.42	141.78
7	1.85	7.28	13.73	23.81	15.81	12.50	11.05	28.20	13.56	127.77
8	10.16	15.59	22.04	32.13	24.13	10.57	2.87	17.54	21.13	156.17
9	6.98	13.58	20.03	30.11	22.11	9.88	5.35	22.24	17.82	148.09
10	11.33	16.09	23.05	33.16	25.13	15.03	7.47	17.69	22.30	171.24
11	14.08	11.03	17.99	27.81	19.76	22.28	14.90	15.58	19.25	162.68
12	6.00	9.07	15.55	25.64	17.63	14.67	10.63	17.90	15.13	132.21
13	8.30	6.49	13.46	23.28	15.23	17.08	13.21	15.53	14.72	127.29
14	10.33	4.49	12.69	21.65	13.60	19.13	15.26	16.24	15.17	128.55
15	10.60	3.22	11.48	18.75	10.70	18.98	17.19	18.76	15.35	125.03
16	8.77	1.32	9.83	17.11	9.06	19.42	18.39	21.69	13.45	119.03
17	6.70	2.88	10.50	19.66	11.61	17.35	15.47	17.84	11.77	113.78
18	5.06	5.38	11.85	21.94	13.94	15.45	12.95	18.72	12.22	117.52
19	3.34	7.36	13.83	23.91	15.91	13.48	10.97	26.62	13.40	128.82
20	16.58	8.79	14.72	20.76	12.93	24.92	22.51	16.42	19.39	157.02
21	15.50	7.70	13.57	18.63	10.88	23.87	21.47	16.96	18.24	146.83
22	14.28	6.48	12.36	17.11	9.36	22.65	20.25	17.23	17.02	136.75
23	11.76	3.97	9.89	17.12	9.07	22.57	19.32	17.65	14.56	125.91
24	12.39	4.41	10.21	14.79	6.74	23.05	22.11	21.30	14.88	129.88
25	13.33	5.36	11.16	15.12	7.36	23.99	21.86	21.02	15.82	135.02
26	14.71	6.73	12.53	15.68	7.93	25.37	22.81	19.68	17.20	142.64
27	15.96	7.98	12.94	11.35	3.51	26.62	25.55	24.39	18.12	146.42
28	14.11	6.71	9.94	12.07	4.03	24.77	23.90	25.26	14.60	135.39
29	15.41	8.01	11.47	9.88	1.83	26.07	25.20	25.35	16.25	139.46
30	17.56	10.16	9.63	8.04	2.17	28.22	27.35	28.29	16.39	147.81
31	19.28	11.88	9.36	6.17	3.80	29.94	29.07	30.44	16.12	156.07
32	23.03	15.63	13.11	7.12	7.55	33.68	32.81	34.19	19.87	186.98
33	8.73	3.15	8.38	17.00	8.96	19.39	18.52	24.44	11.39	119.96
34	12.04	4.64	8.34	13.00	4.95	22.69	21.82	23.18	13.01	123.67
35	12.70	5.94	6.01	13.43	6.34	23.68	22.49	24.50	10.67	125.75
36	11.16	4.40	5.75	14.74	7.76	22.12	20.95	24.01	10.42	121.31
37	8.65	12.92	13.68	24.87	19.29	16.92	21.91	36.26	9.21	163.73
38	3.23	8.04	12.56	22.64	15.25	13.88	14.16	30.03	11.19	130.97
39	4.29	5.84	11.70	21.78	13.78	14.94	14.15	27.81	10.50	124.80
40	6.19	4.05	8.96	19.04	11.24	16.85	15.98	26.01	8.76	117.08
41	8.92	4.58	6.72	16.80	11.22	19.65	18.70	27.21	8.49	122.29
42	6.48	6.48	9.78	19.86	13.77	16.56	16.32	28.68	7.47	125.39
43	10.34	7.03	7.35	17.43	11.86	20.08	20.28	28.10	8.92	131.40
44	17.10	11.24	5.11	9.42	7.24	28.05	26.89	29.80	11.45	146.31
45	17.80	11.93	7.69	8.16	5.53	28.75	27.58	30.50	14.45	152.38
46	20.36	12.96	9.61	4.34	4.88	31.01	30.14	31.52	15.81	160.62
47	19.64	13.78	8.16	5.79	6.55	30.59	29.43	32.66	14.36	160.95
48	20.25	14.38	7.44	6.28	8.84	31.20	30.04	33.26	13.62	165.31
49	13.22	7.62	3.75	14.85	9.99	24.14	23.01	26.24	8.42	131.23
50	15.06	9.20	4.87	11.25	8.49	26.01	24.85	27.76	10.32	137.79
51	17.27	11.41	3.36	10.36	8.20	28.22	27.06	29.97	10.12	145.95
52	15.98	10.65	1.84	11.77	9.72	26.85	25.77	29.21	8.87	140.65
53	16.32	11.46	1.90	11.95	10.85	27.19	26.11	30.38	8.16	144.32
54	19.00	14.13	4.57	9.88	12.81	29.87	28.79	33.06	10.22	162.32
55	19.14	13.27	5.21	8.37	10.59	30.08	28.92	32.15	11.30	159.03
56	15.69	12.10	2.54	14.33	13.14	25.54	26.76	31.03	5.17	146.30
57	18.78	13.91	4.35	12.50	14.50	29.65	28.57	32.84	9.72	164.82
58	15.14	12.03	5.12	18.67	14.71	24.41	29.40	30.96	5.39	155.84
59	21.17	16.30	6.74	8.82	15.48	32.03	30.96	35.23	11.66	178.39
60	23.15	18.28	8.72	11.57	18.57	32.78	32.94	37.21	12.10	195.32
61	20.85	14.99	6.92	6.66	12.12	31.80	30.64	33.86	12.74	170.58
62	23.48	17.44	9.38	4.20	10.38	34.39	33.27	36.49	15.20	184.22
63	25.02	17.63	14.35	1.25	9.55	35.68	34.81	36.19	21.11	195.58
64	24.36	18.49	12.39	3.89	10.89	35.31	34.14	37.37	18.21	195.05
65	25.37	20.51	11.23	5.47	12.47	36.24	35.16	39.12	17.04	202.63
66	23.93	19.06	9.79	6.32	13.32	34.79	33.71	37.98	15.60	194.50
67	23.01	18.14	8.87	7.41	14.41	33.88	32.80	37.07	14.52	190.10
Grand Tota	909.40	692.15	724.09	1082.68	817.19	1525.57	1442.20	1786.50	927.15	9906.92

Transit Travel Time (8am Tuesday)										
	Grocery Stores									
Centroids	1	2	3	4	5	6	7	8	9	Grand Tota
1	17.26	24.26	25.64	45.13	35.13	11.74	15.43	28.85	25.64	229.07
2	12.83	19.83	24.60	40.70	30.70	19.49	23.18	32.56	24.60	228.49
3	4.11	11.11	21.13	32.11	25.11	25.11	25.11	33.73	21.13	198.68
4	5.98	14.53	24.68	35.53	25.66	22.27	19.93	32.27	25.66	206.52
5	13.21	21.85	26.21	38.21	26.21	18.35	12.56	28.35	26.21	211.19
6	12.04	18.59	27.14	39.14	27.14	21.65	17.34	31.65	27.14	221.81
7	3.99	9.22	19.22	30.22	21.22	21.83	21.83	31.83	21.22	180.57
8	14.54	27.54	27.54	39.54	27.54	15.34	5.40	25.25	27.54	210.22
9	13.74	22.29	27.78	39.78	27.78	17.56	10.77	28.16	27.78	215.63
10	18.14	24.25	31.14	43.14	31.14	21.47	13.59	28.08	31.14	242.07
11	21.33	10.33	21.33	32.33	31.77	25.45	25.45	25.45	21.33	214.77
12	11.58	13.70	24.70	35.70	28.21	24.26	20.59	34.21	24.70	217.63
13	17.46	7.69	18.69	29.69	26.57	28.01	21.87	28.21	18.69	196.87
14	20.60	9.60	20.60	31.35	24.73	29.90	24.48	29.90	20.60	211.76
15	20.80	7.23	19.06	26.39	20.85	35.06	28.64	30.69	19.06	207.78
16	16.17	2.18	18.76	24.16	17.16	33.17	32.81	33.23	18.76	196.41
17	13.11	6.29	17.29	27.39	19.96	29.26	28.48	29.26	17.29	188.33
18	10.16	9.40	19.45	30.40	23.30	25.27	25.27	32.93	21.53	197.70
19	5.93	11.63	21.68	32.63	22.45	21.04	21.04	31.04	22.45	189.86
20	22.39	12.39	22.39	27.39	22.39	37.74	30.59	25.94	22.39	223.60
21	24.11	14.11	19.15	29.11	23.47	39.99	31.15	29.99	19.15	230.23
22	21.75	11.75	18.35	26.75	20.36	39.11	28.89	29.11	18.35	214.42
23	17.57	7.23	15.23	22.57	17.57	37.23	27.11	27.58	15.23	187.32
24	18.46	5.83	18.40	21.93	14.85	35.83	32.45	32.86	18.40	199.01
25	20.97	7.97	20.96	24.07	14.43	37.97	33.47	33.47	20.96	214.26
26	24.08	11.08	21.95	26.99	17.17	41.08	33.95	33.95	21.95	232.23
27	20.25	8.42	21.42	19.07	7.50	38.42	38.42	38.42	21.42	213.32
28	21.29	10.96	21.27	22.73	5.17	40.96	39.17	39.58	22.16	223.29
29	21.38	11.12	24.12	20.73	3.71	41.12	41.12	41.12	24.12	228.51
30	21.76	11.12	21.70	17.22	2.80	41.12	41.12	41.12	24.12	222.06
31	23.26	13.26	21.07	12.92	6.59	43.26	43.26	43.26	24.05	230.91
32	29.33	19.33	29.21	14.71	14.73	49.33	49.33	49.33	31.84	287.13
33	14.80	5.93	16.85	25.14	19.37	34.09	34.09	34.60	17.63	202.49
34	19.14	7.48	16.89	22.14	11.04	37.48	33.30	33.72	16.89	198.07
35	17.74	10.94	13.82	17.96	12.31	38.74	35.60	35.60	15.42	198.13
36	16.19	10.10	12.27	19.18	16.72	35.91	33.88	33.88	13.87	191.98
37	19.90	25.46	24.54	36.94	29.54	28.81	28.81	45.17	20.95	260.14
38	7.26	12.90	19.68	32.39	24.68	24.90	24.90	34.90	20.71	202.33
39	9.90	8.42	18.47	29.42	22.42	25.28	25.28	35.28	20.51	194.97
40	12.37	7.24	15.90	27.90	20.15	29.05	29.05	32.86	18.27	192.80
41	13.87	10.31	13.83	23.91	22.59	33.38	33.38	33.38	17.17	201.83
42	14.29	12.49	18.03	26.03	26.03	29.87	29.87	37.38	16.90	210.86
43	17.67	15.18	15.34	24.69	23.37	37.14	37.14	37.14	17.67	225.34
44	23.95	19.06	11.38	17.58	9.81	43.87	38.58	38.58	18.38	221.18
45	22.98	17.50	16.20	13.24	8.01	42.98	40.17	40.17	20.79	222.03
46	26.70	18.23	21.29	8.81	8.74	46.70	41.68	41.68	22.45	236.27
47	25.72	22.00	17.96	12.99	12.52	45.72	43.97	43.97	24.52	249.39
48	29.96	24.30	16.26	14.08	15.13	47.26	43.81	43.81	24.30	258.91
49	15.39	15.46	8.43	21.15	12.92	36.39	35.46	35.46	11.15	191.82
50	19.62	18.57	10.83	17.82	14.40	40.62	38.36	38.36	15.51	214.10
51	24.60	18.02	7.50	19.74	10.48	39.98	37.60	37.60	17.82	213.33
52	22.85	18.39	4.09	23.14	12.31	40.22	38.04	38.04	14.40	211.48
53	24.88	18.68	4.36	25.77	14.93	39.68	39.68	39.68	15.36	223.04
54	28.97	22.13	8.45	23.37	19.86	42.13	42.13	42.13	17.77	246.93
55	28.80	19.79	9.79	19.00	16.11	40.79	40.79	40.79	19.79	235.66
56	26.28	20.48	5.76	30.29	20.08	41.48	41.48	41.48	9.79	237.12
57	30.52	22.67	10.00	28.94	22.67	42.67	42.67	42.67	18.59	261.37
58	28.20	24.70	22.01	34.01	34.01	43.67	43.67	48.90	14.18	293.36
59	35.87	26.93	15.35	21.05	26.64	46.93	46.93	46.93	22.36	288.99
60	38.84	28.84	18.84	22.90	28.84	48.84	48.84	48.84	23.27	308.03
61	32.11	21.11	11.11	16.25	19.97	42.11	42.11	42.11	21.11	247.97
62	30.37	26.39	16.39	10.71	19.81	47.39	47.39	47.39	26.39	272.24
63	33.66	25.60	25.60	6.28	19.42	53.66	44.60	44.60	25.60	278.99
64	29.24	28.44	20.22	9.96	20.24	49.24	49.24	49.24	29.24	285.08
65	30.94	27.61	17.61	13.45	21.94	48.61	48.61	48.61	27.61	284.98
66	34.21	24.34	14.34	15.46	24.34	45.34	45.34	45.34	24.34	273.02
67	34.87	23.87	13.87	17.91	23.87	44.87	44.87	44.87	23.87	272.83
Grand Tota	1382.20	1075.60	1225.10	1669.33	1328.64	2385.13	2235.07	2466.49	1411.14	15178.70

Appendix 2: Gravity matrix by mode in the Study Area

Walking Gravity Matrix										
	Grocery Stores									
Centroids	1	2	3	4	5	6	7	8	9	Grand Tota
1	0.04	0.03	0.02	0.01	0.02	0.26	0.06	0.02	0.02	0.49
2	0.07	0.03	0.02	0.01	0.02	0.08	0.04	0.02	0.03	0.33
3	0.14	0.04	0.03	0.02	0.02	0.05	0.04	0.02	0.04	0.40
4	0.18	0.04	0.03	0.02	0.02	0.05	0.05	0.02	0.03	0.44
5	0.07	0.03	0.02	0.02	0.02	0.05	0.08	0.03	0.02	0.33
6	0.08	0.04	0.02	0.02	0.02	0.04	0.06	0.02	0.03	0.33
7	0.27	0.06	0.03	0.02	0.03	0.04	0.04	0.02	0.04	0.55
8	0.05	0.03	0.02	0.01	0.02	0.06	0.17	0.03	0.02	0.40
9	0.07	0.03	0.02	0.01	0.02	0.05	0.09	0.02	0.03	0.35
10	0.04	0.03	0.02	0.01	0.02	0.04	0.06	0.03	0.02	0.27
11	0.02	0.03	0.02	0.01	0.02	0.02	0.03	0.04	0.02	0.20
12	0.09	0.05	0.03	0.02	0.03	0.03	0.05	0.02	0.03	0.34
13	0.06	0.07	0.03	0.02	0.03	0.03	0.04	0.03	0.03	0.33
14	0.05	0.10	0.04	0.02	0.03	0.02	0.03	0.03	0.03	0.35
15	0.04	0.14	0.04	0.02	0.04	0.02	0.03	0.03	0.03	0.39
16	0.05	0.34	0.05	0.03	0.05	0.02	0.02	0.02	0.03	0.61
17	0.07	0.15	0.04	0.02	0.04	0.03	0.03	0.03	0.04	0.44
18	0.10	0.08	0.04	0.02	0.03	0.03	0.04	0.02	0.04	0.40
19	0.18	0.06	0.03	0.02	0.03	0.04	0.04	0.02	0.04	0.46
20	0.03	0.05	0.03	0.02	0.04	0.02	0.02	0.03	0.02	0.26
21	0.03	0.06	0.03	0.02	0.04	0.02	0.02	0.03	0.02	0.28
22	0.03	0.07	0.04	0.03	0.05	0.02	0.02	0.03	0.03	0.31
23	0.04	0.11	0.05	0.03	0.05	0.02	0.02	0.03	0.03	0.37
24	0.04	0.11	0.04	0.03	0.07	0.02	0.02	0.02	0.03	0.38
25	0.03	0.08	0.04	0.03	0.07	0.02	0.02	0.02	0.03	0.34
26	0.03	0.07	0.04	0.03	0.06	0.02	0.02	0.02	0.03	0.30
27	0.03	0.06	0.04	0.04	0.13	0.02	0.02	0.02	0.03	0.36
28	0.03	0.07	0.05	0.04	0.18	0.02	0.02	0.02	0.03	0.46
29	0.03	0.06	0.04	0.05	0.24	0.02	0.02	0.02	0.03	0.50
30	0.03	0.05	0.05	0.06	0.30	0.02	0.02	0.02	0.03	0.55
31	0.02	0.04	0.05	0.08	0.15	0.01	0.02	0.02	0.03	0.40
32	0.02	0.03	0.03	0.06	0.07	0.01	0.01	0.01	0.02	0.27
33	0.05	0.17	0.05	0.03	0.05	0.02	0.02	0.02	0.04	0.46
34	0.04	0.12	0.05	0.03	0.09	0.02	0.02	0.02	0.04	0.43
35	0.03	0.08	0.07	0.03	0.07	0.02	0.02	0.02	0.04	0.40
36	0.04	0.11	0.08	0.03	0.06	0.02	0.02	0.02	0.04	0.43
37	0.11	0.04	0.03	0.02	0.02	0.04	0.03	0.02	0.04	0.36
38	0.14	0.06	0.04	0.02	0.03	0.03	0.03	0.02	0.05	0.41
39	0.10	0.08	0.04	0.02	0.03	0.03	0.03	0.02	0.05	0.41
40	0.07	0.12	0.05	0.02	0.04	0.03	0.03	0.02	0.05	0.43
41	0.05	0.10	0.07	0.03	0.04	0.02	0.02	0.02	0.05	0.40
42	0.07	0.07	0.05	0.02	0.03	0.03	0.03	0.02	0.06	0.37
43	0.04	0.06	0.06	0.03	0.04	0.02	0.02	0.02	0.07	0.37
44	0.03	0.04	0.09	0.05	0.08	0.02	0.02	0.02	0.04	0.37
45	0.02	0.04	0.06	0.05	0.10	0.02	0.02	0.02	0.03	0.36
46	0.02	0.04	0.05	0.10	0.11	0.01	0.01	0.02	0.03	0.39
47	0.02	0.04	0.05	0.08	0.08	0.01	0.02	0.01	0.03	0.34
48	0.02	0.03	0.06	0.07	0.06	0.01	0.02	0.01	0.03	0.32
49	0.03	0.06	0.12	0.03	0.06	0.02	0.02	0.02	0.05	0.42
50	0.03	0.05	0.09	0.04	0.08	0.02	0.02	0.02	0.04	0.38
51	0.03	0.04	0.13	0.04	0.07	0.02	0.02	0.02	0.04	0.40
52	0.03	0.04	0.24	0.04	0.05	0.02	0.02	0.02	0.05	0.50
53	0.03	0.04	0.23	0.04	0.05	0.02	0.02	0.02	0.06	0.49
54	0.02	0.03	0.10	0.04	0.04	0.01	0.02	0.01	0.04	0.32
55	0.02	0.03	0.09	0.05	0.05	0.02	0.02	0.01	0.04	0.33
56	0.03	0.04	0.17	0.03	0.04	0.02	0.02	0.02	0.09	0.45
57	0.02	0.03	0.10	0.04	0.03	0.02	0.02	0.01	0.05	0.32
58	0.04	0.04	0.12	0.03	0.04	0.02	0.02	0.02	0.10	0.42
59	0.02	0.03	0.07	0.05	0.03	0.01	0.01	0.01	0.04	0.28
60	0.02	0.02	0.05	0.04	0.03	0.01	0.01	0.01	0.04	0.24
61	0.02	0.03	0.06	0.07	0.04	0.01	0.01	0.01	0.03	0.30
62	0.02	0.03	0.05	0.11	0.05	0.01	0.01	0.01	0.03	0.32
63	0.02	0.03	0.03	0.36	0.05	0.01	0.01	0.01	0.02	0.54
64	0.02	0.03	0.04	0.12	0.05	0.01	0.01	0.01	0.02	0.31
65	0.02	0.02	0.04	0.08	0.04	0.01	0.01	0.01	0.03	0.27
66	0.02	0.03	0.05	0.07	0.04	0.01	0.01	0.01	0.03	0.27
67	0.02	0.03	0.05	0.06	0.03	0.01	0.01	0.01	0.03	0.26
Grand Tota	3.37	4.07	3.78	2.82	3.72	1.84	1.91	1.32	2.44	25.28

Biking Gravity Matrix										
	Grocery Stores									
Centroids	1	2	3	4	5	6	7	8	9	Grand Tota
1	0.10	0.06	0.04	0.03	0.04	0.38	0.13	0.05	0.05	0.87
2	0.14	0.07	0.05	0.03	0.04	0.19	0.10	0.04	0.06	0.72
3	0.32	0.10	0.06	0.04	0.05	0.12	0.07	0.04	0.08	0.88
4	0.29	0.10	0.06	0.04	0.05	0.12	0.11	0.04	0.07	0.87
5	0.13	0.08	0.05	0.03	0.05	0.09	0.16	0.05	0.05	0.70
6	0.16	0.09	0.06	0.04	0.05	0.08	0.12	0.05	0.06	0.69
7	0.54	0.14	0.07	0.04	0.06	0.08	0.09	0.04	0.07	1.14
8	0.10	0.06	0.05	0.03	0.04	0.09	0.35	0.06	0.05	0.83
9	0.14	0.07	0.05	0.03	0.05	0.10	0.19	0.04	0.06	0.73
10	0.09	0.06	0.04	0.03	0.04	0.07	0.13	0.06	0.04	0.57
11	0.07	0.09	0.06	0.04	0.05	0.04	0.07	0.06	0.05	0.53
12	0.17	0.11	0.06	0.04	0.06	0.07	0.09	0.06	0.07	0.72
13	0.12	0.15	0.07	0.04	0.07	0.06	0.08	0.06	0.07	0.72
14	0.10	0.22	0.08	0.05	0.07	0.05	0.07	0.06	0.07	0.76
15	0.09	0.31	0.09	0.05	0.09	0.05	0.06	0.05	0.07	0.87
16	0.11	0.76	0.10	0.06	0.11	0.05	0.05	0.05	0.07	1.37
17	0.15	0.35	0.10	0.05	0.09	0.06	0.06	0.06	0.08	0.99
18	0.20	0.19	0.08	0.05	0.07	0.06	0.08	0.05	0.08	0.86
19	0.30	0.14	0.07	0.04	0.06	0.07	0.09	0.04	0.07	0.89
20	0.06	0.11	0.07	0.05	0.08	0.04	0.04	0.06	0.05	0.56
21	0.06	0.13	0.07	0.05	0.09	0.04	0.05	0.06	0.05	0.62
22	0.07	0.15	0.08	0.06	0.11	0.04	0.05	0.06	0.06	0.68
23	0.09	0.25	0.10	0.06	0.11	0.04	0.05	0.06	0.07	0.83
24	0.08	0.23	0.10	0.07	0.15	0.04	0.05	0.05	0.07	0.82
25	0.07	0.19	0.09	0.07	0.14	0.04	0.05	0.05	0.06	0.75
26	0.07	0.15	0.08	0.06	0.13	0.04	0.04	0.05	0.06	0.68
27	0.06	0.13	0.08	0.09	0.28	0.04	0.04	0.04	0.06	0.81
28	0.07	0.15	0.10	0.08	0.25	0.04	0.04	0.04	0.07	0.84
29	0.06	0.12	0.09	0.10	0.55	0.04	0.04	0.04	0.06	1.10
30	0.06	0.10	0.10	0.12	0.46	0.04	0.04	0.04	0.06	1.01
31	0.05	0.08	0.11	0.16	0.26	0.03	0.03	0.03	0.06	0.83
32	0.04	0.06	0.08	0.14	0.13	0.03	0.03	0.03	0.05	0.60
33	0.11	0.32	0.12	0.06	0.11	0.05	0.05	0.04	0.09	0.96
34	0.08	0.22	0.12	0.08	0.20	0.04	0.05	0.04	0.08	0.91
35	0.08	0.17	0.17	0.07	0.16	0.04	0.04	0.04	0.09	0.87
36	0.09	0.23	0.17	0.07	0.13	0.05	0.05	0.04	0.10	0.92
37	0.12	0.08	0.07	0.04	0.05	0.06	0.05	0.03	0.11	0.60
38	0.31	0.12	0.08	0.04	0.07	0.07	0.07	0.03	0.09	0.89
39	0.23	0.17	0.09	0.05	0.07	0.07	0.07	0.04	0.10	0.88
40	0.16	0.25	0.11	0.05	0.09	0.06	0.06	0.04	0.11	0.94
41	0.11	0.22	0.15	0.06	0.09	0.05	0.05	0.04	0.12	0.89
42	0.15	0.15	0.10	0.05	0.07	0.06	0.06	0.03	0.13	0.82
43	0.10	0.14	0.14	0.06	0.08	0.05	0.05	0.04	0.11	0.76
44	0.06	0.09	0.20	0.11	0.14	0.04	0.04	0.03	0.09	0.78
45	0.06	0.08	0.13	0.12	0.18	0.03	0.04	0.03	0.07	0.75
46	0.05	0.08	0.10	0.23	0.21	0.03	0.03	0.03	0.06	0.83
47	0.05	0.07	0.12	0.17	0.15	0.03	0.03	0.03	0.07	0.74
48	0.05	0.07	0.13	0.16	0.11	0.03	0.03	0.03	0.07	0.69
49	0.08	0.13	0.27	0.07	0.10	0.04	0.04	0.04	0.12	0.88
50	0.07	0.11	0.21	0.09	0.12	0.04	0.04	0.04	0.10	0.80
51	0.06	0.09	0.30	0.10	0.12	0.04	0.04	0.03	0.10	0.87
52	0.06	0.09	0.54	0.08	0.10	0.04	0.04	0.03	0.11	1.11
53	0.06	0.09	0.53	0.08	0.09	0.04	0.04	0.03	0.12	1.08
54	0.05	0.07	0.22	0.10	0.08	0.03	0.03	0.03	0.10	0.72
55	0.05	0.08	0.19	0.12	0.09	0.03	0.03	0.03	0.09	0.72
56	0.06	0.08	0.39	0.07	0.08	0.04	0.04	0.03	0.19	0.99
57	0.05	0.07	0.23	0.08	0.07	0.03	0.04	0.03	0.10	0.71
58	0.07	0.08	0.20	0.05	0.07	0.04	0.03	0.03	0.19	0.76
59	0.05	0.06	0.15	0.11	0.06	0.03	0.03	0.03	0.09	0.61
60	0.04	0.05	0.11	0.09	0.05	0.03	0.03	0.03	0.08	0.52
61	0.05	0.07	0.14	0.15	0.08	0.03	0.03	0.03	0.08	0.66
62	0.04	0.06	0.11	0.24	0.10	0.03	0.03	0.03	0.07	0.69
63	0.04	0.06	0.07	0.80	0.10	0.03	0.03	0.03	0.05	1.21
64	0.04	0.05	0.08	0.26	0.09	0.03	0.03	0.03	0.05	0.66
65	0.04	0.05	0.09	0.18	0.08	0.03	0.03	0.03	0.06	0.58
66	0.04	0.05	0.10	0.16	0.08	0.03	0.03	0.03	0.06	0.58
67	0.04	0.06	0.11	0.14	0.07	0.03	0.03	0.03	0.07	0.57
Grand Tota	6.98	8.85	8.43	6.26	7.43	3.75	4.07	2.69	5.33	53.80

Transit Gravity Matrix (8am Tuesday)										
	Grocery Stores									
Centroids	1	2	3	4	5	6	7	8	9	Grand Tota
1	0.06	0.04	0.04	0.02	0.03	0.09	0.06	0.03	0.04	0.41
2	0.08	0.05	0.04	0.02	0.03	0.05	0.04	0.03	0.04	0.39
3	0.24	0.09	0.05	0.03	0.04	0.04	0.04	0.03	0.05	0.61
4	0.17	0.07	0.04	0.03	0.04	0.04	0.05	0.03	0.04	0.51
5	0.08	0.05	0.04	0.03	0.04	0.05	0.08	0.04	0.04	0.43
6	0.08	0.05	0.04	0.03	0.04	0.05	0.06	0.03	0.04	0.41
7	0.25	0.11	0.05	0.03	0.05	0.05	0.05	0.03	0.05	0.66
8	0.07	0.04	0.04	0.03	0.04	0.07	0.19	0.04	0.04	0.53
9	0.07	0.04	0.04	0.03	0.04	0.06	0.09	0.04	0.04	0.44
10	0.06	0.04	0.03	0.02	0.03	0.05	0.07	0.04	0.03	0.37
11	0.05	0.10	0.05	0.03	0.03	0.04	0.04	0.04	0.05	0.42
12	0.09	0.07	0.04	0.03	0.04	0.04	0.05	0.03	0.04	0.42
13	0.06	0.13	0.05	0.03	0.04	0.04	0.05	0.04	0.05	0.48
14	0.05	0.10	0.05	0.03	0.04	0.03	0.04	0.03	0.05	0.43
15	0.05	0.14	0.05	0.04	0.05	0.03	0.03	0.03	0.05	0.47
16	0.06	0.46	0.05	0.04	0.06	0.03	0.03	0.03	0.05	0.82
17	0.08	0.16	0.06	0.04	0.05	0.03	0.04	0.03	0.06	0.54
18	0.10	0.11	0.05	0.03	0.04	0.04	0.04	0.03	0.05	0.49
19	0.17	0.09	0.05	0.03	0.04	0.05	0.05	0.03	0.04	0.55
20	0.04	0.08	0.04	0.04	0.04	0.03	0.03	0.04	0.04	0.39
21	0.04	0.07	0.05	0.03	0.04	0.03	0.03	0.03	0.05	0.38
22	0.05	0.09	0.05	0.04	0.05	0.03	0.03	0.03	0.05	0.42
23	0.06	0.14	0.07	0.04	0.06	0.03	0.04	0.04	0.07	0.53
24	0.05	0.17	0.05	0.05	0.07	0.03	0.03	0.03	0.05	0.54
25	0.05	0.13	0.05	0.04	0.07	0.03	0.03	0.03	0.05	0.47
26	0.04	0.09	0.05	0.04	0.06	0.02	0.03	0.03	0.05	0.40
27	0.05	0.12	0.05	0.05	0.13	0.03	0.03	0.03	0.05	0.53
28	0.05	0.09	0.05	0.04	0.19	0.02	0.03	0.03	0.05	0.54
29	0.05	0.09	0.04	0.05	0.27	0.02	0.02	0.02	0.04	0.61
30	0.05	0.09	0.05	0.06	0.36	0.02	0.02	0.02	0.04	0.71
31	0.04	0.08	0.05	0.08	0.15	0.02	0.02	0.02	0.04	0.51
32	0.03	0.05	0.03	0.07	0.07	0.02	0.02	0.02	0.03	0.35
33	0.07	0.17	0.06	0.04	0.05	0.03	0.03	0.03	0.06	0.53
34	0.05	0.13	0.06	0.05	0.09	0.03	0.03	0.03	0.06	0.53
35	0.06	0.09	0.07	0.06	0.08	0.03	0.03	0.03	0.06	0.50
36	0.06	0.10	0.08	0.05	0.06	0.03	0.03	0.03	0.07	0.51
37	0.05	0.04	0.04	0.03	0.03	0.03	0.03	0.02	0.05	0.33
38	0.14	0.08	0.05	0.03	0.04	0.04	0.04	0.03	0.05	0.49
39	0.10	0.12	0.05	0.03	0.04	0.04	0.04	0.03	0.05	0.51
40	0.08	0.14	0.06	0.04	0.05	0.03	0.03	0.03	0.05	0.52
41	0.07	0.10	0.07	0.04	0.04	0.03	0.03	0.03	0.06	0.48
42	0.07	0.08	0.06	0.04	0.04	0.03	0.03	0.03	0.06	0.44
43	0.06	0.07	0.07	0.04	0.04	0.03	0.03	0.03	0.06	0.41
44	0.04	0.05	0.09	0.06	0.10	0.02	0.03	0.03	0.05	0.47
45	0.04	0.06	0.06	0.08	0.12	0.02	0.02	0.02	0.05	0.48
46	0.04	0.05	0.05	0.11	0.11	0.02	0.02	0.02	0.04	0.48
47	0.04	0.05	0.06	0.08	0.08	0.02	0.02	0.02	0.04	0.40
48	0.03	0.04	0.06	0.07	0.07	0.02	0.02	0.02	0.04	0.38
49	0.06	0.06	0.12	0.05	0.08	0.03	0.03	0.03	0.09	0.55
50	0.05	0.05	0.09	0.06	0.07	0.02	0.03	0.03	0.06	0.46
51	0.04	0.06	0.13	0.05	0.10	0.03	0.03	0.03	0.06	0.51
52	0.04	0.05	0.24	0.04	0.08	0.02	0.03	0.03	0.07	0.61
53	0.04	0.05	0.23	0.04	0.07	0.03	0.03	0.03	0.07	0.57
54	0.03	0.05	0.12	0.04	0.05	0.02	0.02	0.02	0.06	0.42
55	0.03	0.05	0.10	0.05	0.06	0.02	0.02	0.02	0.05	0.43
56	0.04	0.05	0.17	0.03	0.05	0.02	0.02	0.02	0.10	0.52
57	0.03	0.04	0.10	0.03	0.04	0.02	0.02	0.02	0.05	0.38
58	0.04	0.04	0.05	0.03	0.03	0.02	0.02	0.02	0.07	0.32
59	0.03	0.04	0.07	0.05	0.04	0.02	0.02	0.02	0.04	0.32
60	0.03	0.03	0.05	0.04	0.03	0.02	0.02	0.02	0.04	0.30
61	0.03	0.05	0.09	0.06	0.05	0.02	0.02	0.02	0.05	0.40
62	0.03	0.04	0.06	0.09	0.05	0.02	0.02	0.02	0.04	0.38
63	0.03	0.04	0.04	0.16	0.05	0.02	0.02	0.02	0.04	0.42
64	0.03	0.04	0.05	0.10	0.05	0.02	0.02	0.02	0.03	0.36
65	0.03	0.04	0.06	0.07	0.05	0.02	0.02	0.02	0.04	0.34
66	0.03	0.04	0.07	0.06	0.04	0.02	0.02	0.02	0.04	0.35
67	0.03	0.04	0.07	0.06	0.04	0.02	0.02	0.02	0.04	0.35
Grand Tota	4.13	5.44	4.38	3.16	4.41	2.09	2.39	1.88	3.35	31.21

Appendix 3: Gravity matrix by mode in the Sunset

Walking Gravity Matrix																	
	Grocery Stores																
Centroids	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Grand Tota
1	0.03	0.03	0.04	0.04	0.02	0.02	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.12	0.04	0.60
2	0.03	0.03	0.03	0.04	0.02	0.02	0.03	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.25	0.04	0.74
3	0.03	0.03	0.03	0.03	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.63	0.03	1.10
4	0.04	0.04	0.04	0.05	0.02	0.03	0.05	0.05	0.05	0.05	0.03	0.03	0.03	0.03	0.09	0.05	0.66
5	0.05	0.05	0.06	0.06	0.02	0.03	0.06	0.06	0.07	0.06	0.02	0.02	0.02	0.03	0.06	0.06	0.75
6	0.06	0.08	0.09	0.10	0.03	0.03	0.05	0.05	0.05	0.05	0.02	0.02	0.02	0.02	0.05	0.08	0.80
7	0.08	0.09	0.11	0.13	0.03	0.03	0.04	0.04	0.04	0.04	0.02	0.02	0.02	0.02	0.04	0.13	0.87
8	0.09	0.12	0.13	0.18	0.03	0.02	0.04	0.04	0.04	0.04	0.02	0.02	0.02	0.02	0.04	0.18	1.03
9	0.10	0.13	0.14	0.19	0.03	0.02	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.03	0.19	1.04
10	0.40	0.45	0.28	0.20	0.04	0.03	0.04	0.05	0.05	0.05	0.02	0.02	0.02	0.02	0.03	0.08	1.76
11	0.34	0.37	0.25	0.19	0.04	0.03	0.05	0.05	0.05	0.05	0.02	0.02	0.02	0.02	0.03	0.07	1.61
12	0.15	0.25	0.21	0.15	0.04	0.03	0.05	0.06	0.06	0.06	0.02	0.02	0.02	0.02	0.03	0.07	1.24
13	0.11	0.16	0.14	0.11	0.04	0.03	0.06	0.06	0.07	0.06	0.02	0.02	0.02	0.02	0.04	0.06	1.02
14	0.09	0.11	0.10	0.09	0.03	0.04	0.07	0.08	0.08	0.08	0.02	0.02	0.02	0.02	0.04	0.05	0.95
15	0.14	0.10	0.09	0.08	0.05	0.04	0.07	0.08	0.09	0.08	0.02	0.02	0.02	0.02	0.03	0.05	0.99
16	0.12	0.09	0.08	0.07	0.06	0.04	0.07	0.07	0.07	0.07	0.02	0.02	0.02	0.02	0.02	0.05	0.87
17	0.11	0.08	0.08	0.07	0.07	0.04	0.09	0.09	0.08	0.09	0.03	0.02	0.02	0.02	0.02	0.04	0.93
18	0.09	0.07	0.07	0.06	0.06	0.05	0.11	0.11	0.10	0.11	0.03	0.03	0.02	0.02	0.03	0.04	0.97
19	0.07	0.06	0.06	0.05	0.06	0.05	0.15	0.15	0.13	0.15	0.03	0.03	0.02	0.02	0.03	0.04	1.08
20	0.06	0.05	0.05	0.05	0.05	0.06	0.25	0.24	0.19	0.24	0.03	0.03	0.02	0.02	0.03	0.03	1.39
21	0.05	0.04	0.04	0.04	0.07	0.07	0.11	0.10	0.09	0.10	0.04	0.03	0.02	0.02	0.03	0.03	0.86
22	0.07	0.06	0.06	0.05	0.09	0.05	0.07	0.06	0.06	0.06	0.03	0.02	0.02	0.02	0.02	0.04	0.78
23	0.05	0.05	0.04	0.04	0.13	0.06	0.04	0.04	0.04	0.04	0.03	0.02	0.01	0.01	0.02	0.03	0.67
24	0.05	0.05	0.04	0.04	0.20	0.07	0.05	0.05	0.04	0.05	0.03	0.02	0.01	0.01	0.02	0.03	0.77
25	0.05	0.04	0.04	0.04	0.18	0.08	0.06	0.05	0.05	0.05	0.03	0.02	0.01	0.02	0.02	0.03	0.77
26	0.04	0.04	0.04	0.03	0.13	0.11	0.06	0.06	0.06	0.06	0.04	0.02	0.02	0.02	0.02	0.03	0.76
27	0.04	0.03	0.03	0.03	0.10	0.14	0.08	0.07	0.06	0.07	0.04	0.03	0.02	0.02	0.02	0.02	0.80
28	0.03	0.03	0.03	0.03	0.08	0.22	0.09	0.08	0.08	0.08	0.04	0.03	0.02	0.02	0.02	0.02	0.92
29	0.03	0.03	0.03	0.03	0.06	0.20	0.09	0.08	0.07	0.08	0.05	0.03	0.02	0.02	0.03	0.02	0.86
30	0.04	0.04	0.03	0.03	0.16	0.06	0.03	0.03	0.03	0.03	0.02	0.02	0.01	0.01	0.02	0.03	0.60
31	0.04	0.03	0.03	0.03	0.26	0.07	0.04	0.04	0.03	0.04	0.03	0.02	0.01	0.01	0.02	0.03	0.73
32	0.03	0.03	0.03	0.03	0.23	0.09	0.04	0.04	0.04	0.04	0.03	0.02	0.01	0.01	0.02	0.02	0.71
33	0.03	0.03	0.03	0.03	0.15	0.11	0.04	0.04	0.04	0.04	0.03	0.02	0.01	0.01	0.02	0.02	0.67
34	0.03	0.03	0.03	0.03	0.11	0.15	0.05	0.05	0.04	0.05	0.03	0.02	0.01	0.01	0.02	0.02	0.68
35	0.03	0.03	0.03	0.02	0.08	0.24	0.06	0.05	0.05	0.05	0.03	0.02	0.02	0.02	0.02	0.02	0.77
36	0.03	0.02	0.02	0.02	0.07	0.21	0.06	0.05	0.05	0.05	0.04	0.03	0.02	0.02	0.02	0.02	0.72
37	0.02	0.02	0.02	0.02	0.05	0.11	0.04	0.04	0.04	0.04	0.04	0.03	0.02	0.02	0.02	0.02	0.56
38	0.02	0.02	0.02	0.02	0.05	0.10	0.04	0.04	0.04	0.04	0.06	0.03	0.02	0.02	0.03	0.02	0.58
39	0.02	0.02	0.02	0.02	0.04	0.06	0.03	0.03	0.03	0.03	0.10	0.04	0.02	0.02	0.03	0.02	0.54
40	0.02	0.02	0.02	0.02	0.03	0.04	0.03	0.03	0.03	0.03	0.11	0.05	0.02	0.02	0.03	0.01	0.49
41	0.02	0.02	0.02	0.02	0.03	0.05	0.03	0.03	0.03	0.03	0.08	0.04	0.02	0.02	0.03	0.02	0.47
42	0.02	0.02	0.02	0.02	0.03	0.04	0.03	0.03	0.03	0.03	0.08	0.04	0.02	0.02	0.03	0.01	0.45
43	0.03	0.03	0.03	0.02	0.04	0.08	0.07	0.06	0.06	0.06	0.08	0.04	0.02	0.02	0.03	0.02	0.68
44	0.02	0.02	0.02	0.02	0.03	0.05	0.04	0.04	0.04	0.04	0.17	0.05	0.02	0.02	0.04	0.02	0.66
45	0.02	0.02	0.02	0.02	0.03	0.04	0.04	0.03	0.03	0.03	6.45	0.07	0.03	0.03	0.03	0.02	6.91
46	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.17	0.10	0.03	0.03	0.03	0.02	0.64
47	0.02	0.02	0.02	0.02	0.03	0.05	0.03	0.03	0.03	0.03	0.26	0.06	0.02	0.02	0.03	0.02	0.69
48	0.02	0.02	0.02	0.02	0.05	0.09	0.05	0.04	0.04	0.04	0.07	0.04	0.02	0.02	0.03	0.02	0.60
49	0.05	0.04	0.04	0.04	0.05	0.07	0.63	0.36	0.25	0.35	0.04	0.03	0.02	0.02	0.03	0.03	2.05
50	0.04	0.04	0.04	0.04	0.04	0.07	0.48	0.31	0.22	0.30	0.04	0.04	0.02	0.02	0.03	0.03	1.76
51	0.04	0.04	0.04	0.03	0.04	0.06	0.22	0.18	0.14	0.17	0.04	0.04	0.02	0.02	0.04	0.03	1.14
52	0.04	0.03	0.03	0.03	0.03	0.05	0.14	0.12	0.11	0.12	0.05	0.04	0.02	0.02	0.04	0.03	0.91
53	0.03	0.03	0.03	0.03	0.03	0.05	0.10	0.09	0.08	0.09	0.06	0.05	0.02	0.02	0.04	0.02	0.79
54	0.03	0.03	0.03	0.03	0.03	0.04	0.08	0.08	0.07	0.07	0.06	0.06	0.03	0.03	0.05	0.02	0.73
55	0.03	0.03	0.03	0.03	0.03	0.04	0.07	0.06	0.06	0.06	0.08	0.06	0.03	0.03	0.05	0.02	0.70
56	0.05	0.06	0.07	0.07	0.03	0.04	0.07	0.08	0.08	0.08	0.03	0.03	0.03	0.03	0.06	0.05	0.82
57	0.04	0.04	0.05	0.05	0.02	0.03	0.05	0.05	0.05	0.05	0.03	0.03	0.03	0.03	0.10	0.03	0.68
58	0.04	0.04	0.04	0.03	0.02	0.03	0.04	0.05	0.05	0.05	0.04	0.04	0.03	0.03	0.12	0.03	0.67
59	0.04	0.04	0.04	0.03	0.02	0.03	0.06	0.06	0.07	0.06	0.04	0.04	0.03	0.03	0.07	0.03	0.69
60	0.06	0.06	0.05	0.05	0.03	0.04	0.09	0.10	0.11	0.10	0.03	0.03	0.02	0.02	0.05	0.04	0.89
61	0.08	0.07	0.06	0.06	0.03	0.05	0.12	0.14	0.16	0.14	0.03	0.03	0.02	0.02	0.04	0.04	1.09
62	0.03	0.03	0.03	0.03	0.02	0.03	0.04	0.04	0.04	0.04	0.05	0.05	0.04	0.04	0.11	0.02	0.65
63	0.03	0.03	0.03	0.03	0.02	0.02	0.04	0.04	0.04	0.04	0.05	0.06	0.04	0.04	0.09	0.02	0.62
64	0.03	0.03	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.06	0.09	0.05	0.05	0.06	0.02	0.59
65	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.07	0.36	0.04	0.04	0.04	0.02	0.83
66	0.02	0.02	0.02	0.02	0.02	0.03	0.04	0.04	0.04	0.04	0.14	0.13	0.03	0.03	0.04	0.02	0.67
67	0.03	0.02	0.02	0.02	0.02	0.03	0.05	0.05	0.05	0.05	0.12	0.09	0.03	0.03	0.05	0.02	0.69
68	0.03	0.03	0.03	0.02	0.03	0.03	0.06	0.05	0.05	0.05	0.09	0.08	0.03	0.03	0.05	0.02	0.68
69	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.04	0.07	0.09	0.10	0.05	0.02	0.59
70	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.05	0.13	0.06	0.06	0.04	0.02	0.59
71	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.06	0.31	0.05	0.05	0.04	0.02	0.75
72	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.07	0.22	0.04	0.04	0.03	0.02	0.66
73	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.07	0.11	0.03	0.03	0.03	0.01	0.51
Grand Tota	3.94	4.06	3.68	3.45	3.94	4.23	5.41	4.85	4.45	4.81	10.12	3.62	1.81	1.83	3.68	2.61	66.50

Biking Gravity Model																	
	Grocery Stores																
Centroids	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Grand Tota
1	0.07	0.08	0.08	0.08	0.04	0.05	0.08	0.08	0.08	0.08	0.06	0.06	0.07	0.07	0.26	0.09	1.33
2	0.07	0.07	0.08	0.08	0.04	0.05	0.08	0.08	0.08	0.08	0.07	0.06	0.08	0.08	0.56	0.08	1.65
3	0.06	0.07	0.07	0.07	0.04	0.05	0.07	0.07	0.08	0.08	0.07	0.07	0.08	0.09	1.41	0.07	2.46
4	0.09	0.09	0.10	0.11	0.05	0.06	0.10	0.11	0.11	0.11	0.06	0.05	0.06	0.06	0.21	0.10	1.48
5	0.11	0.12	0.13	0.14	0.06	0.07	0.13	0.14	0.15	0.14	0.05	0.05	0.06	0.06	0.14	0.13	1.68
6	0.15	0.18	0.20	0.22	0.06	0.07	0.11	0.11	0.12	0.11	0.05	0.04	0.05	0.05	0.11	0.17	1.80
7	0.17	0.21	0.24	0.28	0.07	0.06	0.09	0.09	0.09	0.09	0.04	0.04	0.05	0.05	0.09	0.28	1.94
8	0.21	0.27	0.30	0.41	0.07	0.05	0.08	0.08	0.09	0.08	0.04	0.04	0.04	0.04	0.09	0.41	2.31
9	0.21	0.28	0.32	0.44	0.06	0.05	0.07	0.08	0.08	0.08	0.04	0.04	0.04	0.04	0.08	0.44	2.35
10	0.91	1.01	0.62	0.45	0.08	0.06	0.10	0.10	0.11	0.10	0.04	0.04	0.04	0.04	0.06	0.17	3.95
11	0.77	0.84	0.56	0.42	0.09	0.07	0.11	0.12	0.12	0.12	0.05	0.04	0.04	0.04	0.07	0.17	3.62
12	0.34	0.57	0.47	0.33	0.09	0.07	0.12	0.13	0.13	0.13	0.05	0.05	0.04	0.04	0.08	0.15	2.79
13	0.25	0.35	0.31	0.24	0.08	0.08	0.13	0.14	0.15	0.15	0.05	0.05	0.05	0.05	0.08	0.13	2.30
14	0.20	0.25	0.23	0.19	0.07	0.08	0.16	0.17	0.18	0.17	0.05	0.05	0.05	0.05	0.09	0.11	2.12
15	0.32	0.23	0.21	0.18	0.11	0.08	0.17	0.18	0.20	0.18	0.05	0.05	0.04	0.04	0.06	0.11	2.23
16	0.26	0.20	0.18	0.16	0.13	0.08	0.16	0.16	0.15	0.16	0.05	0.05	0.03	0.03	0.05	0.10	1.96
17	0.25	0.19	0.17	0.16	0.15	0.09	0.20	0.20	0.18	0.19	0.06	0.05	0.03	0.04	0.05	0.10	2.10
18	0.19	0.16	0.15	0.13	0.14	0.10	0.25	0.25	0.22	0.25	0.06	0.06	0.04	0.04	0.06	0.09	2.18
19	0.16	0.14	0.13	0.12	0.12	0.11	0.34	0.34	0.29	0.34	0.07	0.06	0.04	0.04	0.06	0.08	2.44
20	0.14	0.12	0.11	0.10	0.11	0.13	0.55	0.55	0.42	0.54	0.07	0.07	0.04	0.04	0.06	0.08	3.13
21	0.11	0.10	0.10	0.09	0.16	0.16	0.25	0.22	0.19	0.22	0.08	0.06	0.04	0.04	0.06	0.07	1.93
22	0.17	0.14	0.13	0.12	0.21	0.11	0.15	0.14	0.13	0.14	0.06	0.05	0.03	0.03	0.05	0.08	1.75
23	0.12	0.10	0.10	0.09	0.30	0.13	0.10	0.09	0.09	0.09	0.06	0.04	0.03	0.03	0.04	0.07	1.50
24	0.12	0.10	0.10	0.09	0.46	0.16	0.11	0.10	0.10	0.10	0.07	0.05	0.03	0.03	0.04	0.07	1.73
25	0.10	0.09	0.09	0.08	0.41	0.19	0.13	0.12	0.11	0.12	0.08	0.05	0.03	0.03	0.05	0.06	1.73
26	0.09	0.08	0.08	0.08	0.28	0.24	0.15	0.14	0.13	0.13	0.08	0.05	0.03	0.03	0.05	0.06	1.71
27	0.08	0.08	0.07	0.07	0.22	0.32	0.17	0.16	0.15	0.16	0.09	0.06	0.04	0.03	0.05	0.06	1.80
28	0.08	0.07	0.07	0.07	0.17	0.50	0.21	0.19	0.17	0.19	0.10	0.06	0.04	0.04	0.05	0.05	2.06
29	0.07	0.07	0.06	0.06	0.15	0.44	0.20	0.18	0.17	0.18	0.11	0.06	0.04	0.04	0.06	0.05	1.94
30	0.09	0.08	0.08	0.07	0.36	0.14	0.08	0.07	0.07	0.07	0.05	0.04	0.03	0.03	0.04	0.06	1.34
31	0.09	0.08	0.07	0.07	0.60	0.16	0.08	0.08	0.08	0.08	0.06	0.04	0.03	0.03	0.04	0.06	1.64
32	0.08	0.07	0.07	0.07	0.51	0.19	0.09	0.09	0.08	0.09	0.06	0.05	0.03	0.03	0.04	0.05	1.60
33	0.07	0.07	0.07	0.06	0.33	0.25	0.10	0.10	0.09	0.10	0.07	0.05	0.03	0.03	0.04	0.05	1.50
34	0.07	0.06	0.06	0.06	0.24	0.34	0.11	0.11	0.10	0.11	0.07	0.05	0.03	0.03	0.04	0.05	1.54
35	0.06	0.06	0.06	0.05	0.19	0.54	0.13	0.12	0.11	0.12	0.08	0.05	0.03	0.03	0.05	0.05	1.74
36	0.06	0.05	0.05	0.05	0.16	0.47	0.12	0.12	0.11	0.12	0.08	0.06	0.04	0.04	0.05	0.04	1.61
37	0.05	0.05	0.05	0.05	0.12	0.24	0.10	0.10	0.09	0.09	0.09	0.06	0.04	0.04	0.05	0.04	1.25
38	0.05	0.05	0.05	0.05	0.12	0.23	0.10	0.09	0.09	0.09	0.13	0.07	0.04	0.04	0.06	0.04	1.30
39	0.04	0.04	0.04	0.04	0.08	0.13	0.07	0.07	0.07	0.07	0.23	0.10	0.05	0.05	0.07	0.03	1.20
40	0.04	0.04	0.04	0.04	0.07	0.09	0.06	0.06	0.06	0.06	0.24	0.12	0.05	0.05	0.06	0.03	1.10
41	0.04	0.04	0.04	0.04	0.07	0.11	0.07	0.06	0.06	0.06	0.14	0.08	0.04	0.04	0.06	0.03	1.00
42	0.03	0.03	0.03	0.03	0.05	0.07	0.05	0.05	0.05	0.05	0.12	0.09	0.05	0.05	0.05	0.03	0.83
43	0.06	0.05	0.05	0.05	0.10	0.18	0.12	0.11	0.11	0.11	0.17	0.08	0.04	0.04	0.07	0.04	1.40
44	0.05	0.05	0.05	0.05	0.07	0.11	0.10	0.09	0.09	0.09	0.36	0.11	0.05	0.05	0.09	0.04	1.45
45	0.05	0.04	0.04	0.04	0.06	0.09	0.08	0.08	0.07	0.08	14.54	0.14	0.06	0.06	0.08	0.04	15.55
46	0.04	0.04	0.04	0.04	0.06	0.07	0.07	0.07	0.07	0.07	0.38	0.17	0.07	0.07	0.07	0.03	1.36
47	0.04	0.04	0.04	0.04	0.07	0.11	0.07	0.07	0.07	0.07	0.59	0.13	0.06	0.06	0.07	0.03	1.55
48	0.05	0.05	0.05	0.05	0.10	0.20	0.10	0.10	0.09	0.10	0.17	0.08	0.04	0.04	0.07	0.04	1.33
49	0.11	0.10	0.10	0.09	0.10	0.16	1.43	0.82	0.56	0.79	0.08	0.07	0.04	0.04	0.07	0.07	4.62
50	0.10	0.09	0.09	0.08	0.09	0.16	1.09	0.69	0.50	0.67	0.09	0.08	0.04	0.04	0.07	0.06	3.95
51	0.09	0.08	0.08	0.07	0.08	0.14	0.50	0.39	0.32	0.39	0.10	0.09	0.04	0.05	0.08	0.06	2.56
52	0.08	0.07	0.07	0.07	0.08	0.12	0.32	0.27	0.24	0.27	0.11	0.10	0.05	0.05	0.09	0.05	2.04
53	0.07	0.07	0.07	0.06	0.07	0.10	0.23	0.21	0.19	0.21	0.12	0.11	0.05	0.05	0.10	0.05	1.77
54	0.07	0.06	0.06	0.06	0.07	0.09	0.19	0.17	0.16	0.17	0.14	0.12	0.06	0.05	0.11	0.05	1.63
55	0.06	0.06	0.06	0.06	0.06	0.09	0.16	0.14	0.13	0.14	0.17	0.14	0.06	0.06	0.12	0.05	1.56
56	0.12	0.14	0.15	0.16	0.06	0.08	0.16	0.17	0.18	0.17	0.06	0.05	0.06	0.06	0.13	0.10	1.84
57	0.09	0.09	0.10	0.10	0.05	0.06	0.10	0.11	0.11	0.11	0.07	0.07	0.07	0.07	0.23	0.08	1.51
58	0.08	0.08	0.08	0.07	0.05	0.06	0.10	0.10	0.11	0.10	0.10	0.09	0.07	0.08	0.27	0.06	1.49
59	0.09	0.09	0.08	0.08	0.06	0.07	0.13	0.14	0.15	0.14	0.09	0.08	0.06	0.06	0.16	0.06	1.53
60	0.14	0.13	0.12	0.11	0.07	0.10	0.22	0.25	0.27	0.25	0.07	0.06	0.05	0.05	0.10	0.08	2.07
61	0.18	0.15	0.14	0.13	0.08	0.10	0.27	0.31	0.35	0.32	0.06	0.06	0.05	0.05	0.09	0.09	2.44
62	0.07	0.08	0.07	0.07	0.05	0.06	0.09	0.09	0.09	0.09	0.11	0.10	0.08	0.08	0.25	0.06	1.43
63	0.07	0.07	0.07	0.06	0.04	0.05	0.08	0.08	0.09	0.08	0.12	0.11	0.09	0.09	0.20	0.05	1.36
64	0.04	0.04	0.04	0.04	0.04	0.05	0.07	0.06	0.06	0.06	0.11	0.18	0.09	0.09	0.08	0.04	1.10
65	0.04	0.04	0.04	0.04	0.05	0.06	0.07	0.07	0.07	0.07	0.16	0.63	0.08	0.08	0.07	0.04	1.62
66	0.05	0.05	0.04	0.04	0.05	0.07	0.09	0.08	0.08	0.08	0.31	0.25	0.07	0.07	0.08	0.04	1.46
67	0.06	0.05	0.05	0.05	0.05	0.07	0.12	0.11	0.10	0.11	0.27	0.20	0.07	0.07	0.10	0.04	1.53
68	0.06	0.06	0.06	0.05	0.06	0.08	0.13	0.12	0.12	0.12	0.21	0.17	0.06	0.06	0.12	0.04	1.52
69	0.04	0.05	0.05	0.05	0.03	0.04	0.05	0.05	0.05	0.05	0.08	0.17	0.20	0.19	0.12	0.04	1.28
70	0.04	0.04	0.04	0.04	0.04	0.05	0.06	0.06	0.06	0.06	0.10	0.28	0.12	0.13	0.09	0.04	1.26
71	0.04	0.04	0.04	0.04	0.04	0.05	0.06	0.06	0.06	0.06	0.12	0.69	0.11	0.11	0.08	0.04	1.64
72	0.04	0.04	0.04	0.04	0.04	0.06	0.07	0.07	0.06	0.07	0.15	0.49	0.09	0.09	0.07	0.03	1.45
73	0.04	0.04	0.04	0.04	0.04	0.06	0.06	0.06	0.06	0.06	0.13	0.24	0.08	0.08	0.06	0.03	1.11
Grand Tota	8.82	9.07	8.23	7.72	8.85	9.48	12.12	10.87	9.98	10.78	22.59	7.70	3.92	3.95	8.13	5.79	148.00

Transit Gravity Matrix (8am Tuesday)																	
	Grocery Stores																
Centroids	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Grand Tota
1	0.04	0.04	0.04	0.07	0.03	0.03	0.05	0.05	0.05	0.05	0.05	0.04	0.06	0.06	0.12	0.04	0.81
2	0.04	0.04	0.04	0.07	0.03	0.03	0.06	0.06	0.06	0.06	0.06	0.04	0.06	0.06	0.25	0.04	0.98
3	0.04	0.04	0.04	0.07	0.03	0.03	0.05	0.05	0.05	0.05	0.07	0.04	0.07	0.07	0.63	0.04	1.37
4	0.04	0.06	0.06	0.09	0.03	0.03	0.05	0.05	0.05	0.05	0.05	0.04	0.05	0.05	0.10	0.05	0.86
5	0.06	0.08	0.08	0.11	0.04	0.04	0.07	0.07	0.07	0.07	0.04	0.04	0.05	0.05	0.07	0.06	1.00
6	0.08	0.10	0.10	0.16	0.05	0.04	0.07	0.07	0.07	0.07	0.04	0.03	0.05	0.05	0.05	0.08	1.10
7	0.10	0.10	0.11	0.13	0.05	0.03	0.06	0.06	0.06	0.06	0.03	0.03	0.04	0.04	0.04	0.13	1.06
8	0.10	0.12	0.14	0.18	0.05	0.04	0.05	0.05	0.05	0.05	0.04	0.03	0.04	0.04	0.04	0.18	1.22
9	0.10	0.13	0.19	0.19	0.05	0.04	0.06	0.06	0.06	0.06	0.04	0.03	0.04	0.04	0.04	0.19	1.32
10	0.40	0.45	0.27	0.20	0.06	0.05	0.06	0.06	0.06	0.06	0.05	0.03	0.04	0.04	0.04	0.08	1.93
11	0.35	0.38	0.25	0.19	0.06	0.04	0.06	0.06	0.06	0.06	0.04	0.03	0.04	0.04	0.04	0.07	1.79
12	0.15	0.25	0.21	0.15	0.06	0.04	0.07	0.07	0.07	0.07	0.04	0.03	0.04	0.04	0.04	0.07	1.41
13	0.11	0.18	0.18	0.11	0.05	0.04	0.08	0.08	0.08	0.08	0.04	0.03	0.04	0.04	0.04	0.06	1.25
14	0.09	0.16	0.16	0.09	0.05	0.04	0.09	0.09	0.09	0.09	0.04	0.03	0.04	0.04	0.05	0.05	1.19
15	0.14	0.11	0.11	0.11	0.07	0.04	0.07	0.08	0.09	0.08	0.04	0.03	0.03	0.03	0.04	0.05	1.15
16	0.12	0.09	0.08	0.08	0.07	0.05	0.07	0.07	0.07	0.07	0.05	0.03	0.03	0.03	0.03	0.05	1.00
17	0.11	0.10	0.10	0.10	0.08	0.05	0.09	0.09	0.09	0.09	0.05	0.03	0.03	0.03	0.03	0.04	1.11
18	0.09	0.09	0.09	0.09	0.08	0.05	0.11	0.11	0.11	0.11	0.05	0.03	0.03	0.03	0.04	0.04	1.18
19	0.08	0.08	0.08	0.08	0.06	0.06	0.15	0.15	0.15	0.15	0.06	0.03	0.03	0.03	0.04	0.04	1.27
20	0.06	0.08	0.08	0.06	0.06	0.06	0.25	0.24	0.25	0.24	0.06	0.04	0.04	0.04	0.04	0.04	1.61
21	0.07	0.07	0.07	0.07	0.07	0.08	0.11	0.10	0.10	0.10	0.08	0.04	0.04	0.04	0.04	0.04	1.13
22	0.09	0.09	0.09	0.09	0.10	0.07	0.07	0.07	0.07	0.07	0.07	0.04	0.04	0.04	0.04	0.04	1.05
23	0.06	0.06	0.06	0.06	0.13	0.06	0.05	0.05	0.05	0.05	0.05	0.03	0.03	0.03	0.03	0.04	0.86
24	0.07	0.07	0.07	0.07	0.20	0.07	0.05	0.05	0.05	0.05	0.05	0.03	0.03	0.03	0.03	0.04	1.00
25	0.07	0.07	0.07	0.07	0.18	0.08	0.06	0.05	0.05	0.05	0.05	0.03	0.03	0.03	0.03	0.04	1.00
26	0.06	0.06	0.06	0.06	0.13	0.11	0.06	0.06	0.06	0.06	0.06	0.03	0.03	0.03	0.03	0.03	0.95
27	0.05	0.06	0.06	0.05	0.10	0.14	0.08	0.07	0.07	0.07	0.06	0.04	0.04	0.04	0.04	0.03	0.99
28	0.05	0.08	0.08	0.05	0.08	0.22	0.09	0.08	0.08	0.08	0.06	0.04	0.04	0.04	0.04	0.04	1.14
29	0.05	0.07	0.07	0.05	0.07	0.20	0.09	0.08	0.07	0.08	0.06	0.04	0.04	0.04	0.04	0.04	1.08
30	0.05	0.05	0.05	0.05	0.16	0.06	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.80
31	0.06	0.06	0.06	0.06	0.26	0.07	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.97
32	0.06	0.06	0.06	0.06	0.23	0.09	0.05	0.05	0.05	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.96
33	0.06	0.06	0.06	0.06	0.15	0.11	0.05	0.05	0.05	0.05	0.04	0.04	0.04	0.04	0.04	0.03	0.92
34	0.06	0.06	0.06	0.06	0.11	0.15	0.06	0.06	0.06	0.06	0.04	0.04	0.04	0.04	0.04	0.03	0.95
35	0.05	0.07	0.07	0.05	0.08	0.24	0.07	0.07	0.07	0.07	0.04	0.04	0.04	0.04	0.04	0.04	1.09
36	0.05	0.07	0.07	0.05	0.07	0.21	0.07	0.07	0.07	0.07	0.04	0.04	0.04	0.04	0.04	0.04	1.03
37	0.05	0.06	0.06	0.05	0.06	0.11	0.06	0.06	0.06	0.06	0.04	0.04	0.04	0.04	0.04	0.03	0.86
38	0.05	0.05	0.05	0.05	0.05	0.10	0.05	0.05	0.05	0.05	0.06	0.04	0.04	0.04	0.05	0.03	0.80
39	0.04	0.04	0.04	0.04	0.04	0.06	0.04	0.04	0.04	0.04	0.10	0.05	0.05	0.05	0.06	0.03	0.79
40	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.11	0.06	0.06	0.06	0.05	0.03	0.79
41	0.04	0.04	0.04	0.04	0.04	0.05	0.04	0.04	0.04	0.04	0.08	0.05	0.05	0.05	0.05	0.03	0.72
42	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.06	0.04	0.04	0.04	0.04	0.02	0.58
43	0.04	0.05	0.05	0.04	0.05	0.08	0.06	0.06	0.06	0.06	0.07	0.04	0.04	0.04	0.06	0.03	0.83
44	0.04	0.04	0.04	0.04	0.04	0.05	0.05	0.05	0.05	0.05	0.17	0.05	0.05	0.05	0.08	0.03	0.89
45	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	1.00	0.06	0.05	0.05	0.06	0.03	1.66
46	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.20	0.09	0.08	0.08	0.04	0.03	0.92
47	0.04	0.04	0.04	0.04	0.04	0.05	0.04	0.04	0.04	0.04	0.26	0.05	0.05	0.05	0.05	0.03	0.90
48	0.04	0.04	0.04	0.04	0.05	0.09	0.05	0.05	0.05	0.05	0.07	0.04	0.04	0.04	0.05	0.03	0.79
49	0.05	0.09	0.09	0.05	0.05	0.07	0.64	0.36	0.26	0.35	0.07	0.04	0.04	0.04	0.05	0.04	2.30
50	0.05	0.09	0.09	0.05	0.05	0.07	0.48	0.31	0.23	0.30	0.07	0.04	0.04	0.04	0.06	0.04	1.98
51	0.05	0.07	0.07	0.05	0.05	0.06	0.22	0.17	0.15	0.17	0.07	0.04	0.04	0.04	0.07	0.04	1.35
52	0.05	0.06	0.06	0.05	0.05	0.05	0.14	0.12	0.11	0.12	0.07	0.04	0.04	0.04	0.08	0.03	1.11
53	0.04	0.05	0.05	0.04	0.04	0.05	0.10	0.09	0.08	0.09	0.08	0.05	0.04	0.04	0.08	0.03	0.97
54	0.04	0.05	0.05	0.04	0.04	0.04	0.08	0.08	0.07	0.07	0.08	0.05	0.04	0.04	0.07	0.03	0.89
55	0.04	0.04	0.04	0.05	0.04	0.04	0.07	0.06	0.06	0.06	0.10	0.06	0.05	0.05	0.09	0.03	0.88
56	0.06	0.10	0.10	0.09	0.04	0.04	0.09	0.09	0.09	0.09	0.04	0.03	0.05	0.05	0.07	0.05	1.08
57	0.04	0.06	0.06	0.08	0.03	0.03	0.06	0.06	0.06	0.06	0.05	0.04	0.06	0.06	0.10	0.04	0.90
58	0.04	0.05	0.05	0.06	0.03	0.03	0.05	0.05	0.05	0.05	0.07	0.04	0.06	0.06	0.13	0.04	0.85
59	0.04	0.05	0.05	0.05	0.03	0.03	0.06	0.06	0.06	0.06	0.07	0.04	0.05	0.05	0.09	0.03	0.83
60	0.06	0.10	0.10	0.06	0.04	0.04	0.10	0.11	0.11	0.11	0.05	0.03	0.04	0.04	0.06	0.04	1.12
61	0.08	0.11	0.11	0.06	0.05	0.05	0.12	0.14	0.14	0.14	0.05	0.03	0.04	0.04	0.05	0.05	1.26
62	0.03	0.04	0.04	0.06	0.03	0.03	0.04	0.04	0.04	0.04	0.07	0.04	0.06	0.06	0.12	0.04	0.79
63	0.03	0.04	0.04	0.05	0.03	0.03	0.04	0.04	0.04	0.04	0.06	0.05	0.06	0.06	0.10	0.03	0.74
64	0.03	0.03	0.03	0.04	0.03	0.03	0.04	0.04	0.04	0.04	0.06	0.06	0.05	0.05	0.06	0.03	0.68
65	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.10	0.55	0.10	0.10	0.04	0.03	1.27
66	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.14	0.11	0.08	0.08	0.05	0.03	0.94
67	0.04	0.04	0.04	0.04	0.04	0.04	0.05	0.05	0.05	0.05	0.12	0.09	0.06	0.06	0.07	0.03	0.86
68	0.04	0.04	0.04	0.05	0.04	0.04	0.06	0.05	0.05	0.05	0.09	0.08	0.05	0.05	0.08	0.03	0.85
69	0.03	0.03	0.03	0.05	0.03	0.03	0.03	0.03	0.03	0.03	0.07	0.08	0.11	0.10	0.05	0.04	0.76
70	0.03	0.03	0.03	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.07	0.14	0.09	0.09	0.04	0.03	0.79
71	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.07	0.43	0.08	0.08	0.04	0.03	1.07
72	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.08	0.18	0.07	0.07	0.04	0.03	0.88
73	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.08	0.10	0.06	0.06	0.04	0.03	0.74
Grand Tota	4.83	5.64	5.36	5.05	4.70	4.57	5.93	5.37	5.13	5.34	5.87	4.30	3.48	3.47	4.75	3.18	76.97

Appendix 4: Infrastructure scoring

The Study Area

Main Thoroughfare			1. Manilla Oriental Market - Mission St.			2. Safeway - Mission St.			3. Whole Foods - Ocean Ave.			4. H Mart - Alemany			5. Pacific Supermarket - Alemany			6. Alemany Farmers - Alemany Blvd			8. Grocery Outlet - Bayshore Blvd			9. Safeway - Monterey Blvd		
Precedent Treatment Type		Precedent Elements	Existing	Percent of elements	Score	Existing	Percent of elements	Score	Existing	Percent of elements	Score	Existing	Percent of elements	Score	Existing	Percent of elements	Score	Existing	Percent of elements	Score	Existing	Percent of elements	Score	Existing	Percent of elements	Score
Complete Street: high traffic, high collision rates, KSI, multiple lanes, large intersections	Bike	Bike boxes																1								
		Bike signals																								
		Bike parking							1																	
		Protected bike lanes (through intersections)																1								
		Striping through intersections																1								
		Wayfinding/signage																1			1					
		Dedicated turn lanes/ turn restrictions		0%	0		0%	0		14%	1	1	14%	1		0%	0	1	71%	4		14%	1	1	14%	1
	Transit	Safe loading and unloading zones/stations	1			1			1									1			1			1		
		Well located stops/stations	1			1			1									1			1			1		
		Bus shelter	1			1			1			1									1			1		
		Bus only lanes		75%	4		75%	3		75%	3		25%	1		0%	0		50%	3		75%	4		75%	2
	Pedestrian	Curb extensions/bulbouts/painted safety zones							1									1			1			1		
		Wide sidewalks	1			1			1			1			1			1						1		
		Signalized intersections	0.5												1			1			1					
		Accessible pavement conditions	1			1			1			1						1						1		
		High visibility continental crosswalks				1			0.5			1			1			1			0.5			1.5		
		Improved corner sight distance (daylighting and stop bars)	1			1			1															1		
		Medians and pedestrian refuge islands																			1					
		Midblock crossings																								
		Pedestrian head starts	1	50%	2		44%	3	1	61%	4		33%	3	1	44%	3	1	67%	3	1	50%	3	1	72%	4
	Comfort and aesthetic	Parklets							1																	
		Designated loading zones							1			1						1								
		Street furniture				1			1												1			1		
		Tree coverage and sustainable landscaping		0%	0	1	50%	3	1	100%	5	1	50%	5	1	25%	1		25%	1	1	50%	3	1	50%	3
Notes			Poorly organized parking lot No crosswalk and no ped signal or flashing be			Construction - obstructed sidewalk oppo Painted safety zones and safe hit posts No light at intersection of store			Two intersections did not have signals Sharrows M train Some faded striping Witness vehicle crash (rear end?) at int I think car stopped to yield ped Wide crossings High speeds			Stop sign at intersection off of freeway Bad placement of 54 and 28 bus stop No sight distance Cars turning right off of Arch don't see No bike infrastructure Ped signal doesn't work unless button i			Buffered bike lanes Good shade Plants in sidewalk/cracked sidewalks Lack of sight distance at intersections 4 lanes with median but not median fo Long sidewalks unlikley people can wal			Poor landscaping Confusing intersection Not friendly and very long Green bike striping through parts of int Really steep hills Long streets difficult to reach from home			Long street Lacking continental crosswalks and pair Train platform Narrow sidewalks Class 2 bike lane			Opportunity for midblock crossing Nice sidewalks		

Scoring	
Score	Percent
1	1-20%
2	21-40%
3	41-60%
4	61-80%
5	81-100%

Neighborhood Main Street				7. Grocery Outlet - Silver Ave	
Precedent Treatment Type		Precedent Elements	Existing	Percent of elements	Score
Neighborhood Main Street: high traffic of all modes, mid to high speeds, high collision rates, 1 lane per direction	Bike	Bike lane			
		Buffer			
		Bike parking	1		
		Green lanes		25%	1
	Transit	Safe loading and unloading zones/stations	1		
		Well located stops/stations	1		
		Bus shelter		67%	4
	Pedestrian	Curb extensions/bulbouts/painted safety zones	1		
		Chicanes, traffic calming			
		Wide sidewalks			
		Accessible pavement conditions	1		
		High visibility continental crosswalks	1		
		Improved corner sight distance (daylighting and stop bars)			
		Stop signs	0.5		
		Near slow street	1	56%	3
	Comfort and aesthetic	Parklets			
		Bioswales, landscaping			
		Street furniture	1		
		Tree coverage and sustainable landscaping	1	50%	3

Notes

Slow street
Sharrows
Very narrow street - too many cars for

Scoring	
Score	Percent
1	1-20%
2	21-40%
3	41-60%
4	61-80%
5	81-100%

Main Thoroughfare			12. Lucky - Sloat Blvd.			13. Whole Foods - 19th Ave			14. Trader Joe's - 19th Ave			15. Safeway - Taraval St.		
Precedent Treatment Type		Precedent Elements	Existing	Percent of elements	Score	Existing	Percent of elements	Score	Existing	Percent of elements	Score	Existing	Percent of elements	Score
Complete Street: high traffic, high collision rates, KSI, multiple lanes, large intersections	Bike	Bike boxes												
		Bike signals												
		Bike parking				1			1					
		Protected bike lanes (through intersections)												
		Striping through intersections												
		Wayfinding/signage												
		Dedicated turn lanes/ turn restrictions	1	14%	1	1	29%	2	1	29%	2		0%	0
	Transit	Safe loading and unloading zones/stations	1			1			1			0.5		
		Well located stops/stations	1			1			1			1		
		Bus shelter	1			1			1			0.5		
		Bus only lanes		75%	4	1	100%	5	1	100%	5	1	75%	4
	Pedestrian	Curb extensions/bulbouts/painted safety zones	0.5											
		Wide sidewalks				0.5			0.5			1		
		Signalized intersections	1			1			1					
		Accessible pavement conditions	1									1		
		High visibility continental crosswalks	1			1			1			1		
		Improved corner sight distance (daylighting and stop bars)	1			1			1			1		
		Medians and pedestrian refuge islands	1			1			1			0.5		
		Midblock crossings												
		Pedestrian head starts	1	72%	4	1	61%	4	1	61%	4	1	61%	4
	Comfort and aesthetic	Parklets												
		Designated loading zones				1			1			1		
		Street furniture	1			1			1			1		
		Tree coverage and sustainable landscaping	1	50%	3	1	75%	4	1	75%	4	1	75%	4
Notes			Buffered bike lanes Sharrows as turn lane to enter parking Two lanes each direction Center median Signal Bike lane is bus stop Crossing on one side of intersection only			Winston has sharrows but not good for Not walkable on other streets (long dis Long intersections but does have media Good transit options Narrow sidewalk inbound			Winston has sharrows but not good for Not walkable on other streets (long dis Long intersections but does have media Good transit options Narrow sidewalk inbound			No signals No bike infrastructure Good transit Bus shelter on 19th Need better loading Loading zone in one direction but must cross traffic on other side		

Scoring	
Score	Percent
1	1-20%
2	21-40%
3	41-60%
4	61-80%
5	81-100%

Neighborhood Main Street			2. S&B Supermarket - Irving St.			3. 22nd and Irving Market - Irving St			4. Sunrise Irving Market - Irving St.			7. Boss Supermarket - Noreiga St.			. Noriega Food Market - Noriega S			9. Superb Garden Grocery			10. Safeway - Noreiga			12. Lucky - Ocean Ave.		
Precedent Treatment Type		Precedent Elements	Existing	Percent of elements	Score	Existing	Percent of elements	Score	Existing	Percent of elements	Score	Existing	Percent of elements	Score	Existing	Percent of elements	Score	Existing	Percent of elements	Score	Existing	Percent of elements	Score	Existing	Percent of elements	Score
Neighborhood Main Street: high traffic of all modes, mid to high speeds, high collision rates, 1 lane per direction	Bike	Bike lane							0.5													1				
		Buffer							0.5													1				
		Bike parking	1			1			1												1					
		Green paint		25%	1		25%	2		50%	3		0%	0	1	25%	2	1	25%	2		25%	2		50%	3
	Transit	Safe loading and unloading zones/stations	1			1			1			1			1			1			1			1		
		Well located stops/stations	1			1			0.5			1			1			1			1					
		Bus shelter	1	100%	4	1	100%	5	1	83%	5		67%	4		67%	4		67%	4		67%	4	1	67%	4
	Pedestrian	Curb extensions/bulbouts/painted safety zones	1			1			1																	
		Chicanes, traffic calming	1			1			1			1			1			1			0.5			1		
		Wide sidewalks	1			1			1			1			1			1			1					
		Accessible pavement conditions	1			1			1			1			1			1						1		
		High visibility continental crosswalks	1			1.5			1.5			0.5			1			1			0.5			1		
		Improved corner sight distance (daylighting and stop bars)	0.5			1			1			0.5			0.5			0.5			1			1		
		Stop signs				1			1.5						0.5			0.5			1			0.5		
		Near slow street	1	81%	5	1	106%	5	1	113%	5	1	63%	4	1	75%	4	1	75%	4	1	63%	4		56%	3
	Comfort and aesthetic	Parklets	1			1			1						1			1								
		Bioswales, landscaping				1			1			1												1		
		Street furniture	1			1			1			1			1			1			1					
		Tree coverage and sustainable landscaping		50%	3		75%	4		75%	4		50%	3	1	75%	4	1	75%	4	1	50%	3	1	50%	3
Notes			Perpendicular parking 7 and N line Sight distance could be impeded by per No bike infrastructure besides parking two slow streets nearby			Perpendicular parking 7 and N line Extra bulbouts No bike infrastructure besides parking two slow streets nearby Colored crosswalks Street furniture/obelisks			Buffered bike lane on 20th Colored crosswalks Street furniture/obelisks Signal at one intersection			No stop signs Bus stops about 1 block away in each d Chicanes Parallel parking			Stop sign on one side only Good sight distance in one direction on Chicanes Perpendicular parking Short metered parking - lots of moving Vehicles in chicane			Stop sign on one side only Good sight distance in one direction on Chicanes Perpendicular parking Short metered parking - lots of moving Vehicles in chicane			Chicanes Perpendicular parking Short metered parking - lots of moving Painted chicanes Driveway from Safeway parking lot inte			Wide street Bike lanes and some buffers Painted chicanes Left turn lane to parking lot Easy entrance to Lucky parking lot and store from street		

Scoring	
Score	Percent
1	1-20%
2	21-40%
3	41-60%
4	61-80%
5	81-100%

Neighborhood small streets			1. Sunset Super - Irving St.			5. Other Avenues - Judah St.			6. Gus's Community Market			1. SM Sunset Supermarket - Vicent			16. Andronico's - Irving St.		
Precedent Treatment Type		Precedent Elements	Existing	Percent of elements	Score	Existing	Percent of elements	Score	Existing	Percent of elements	Score	Existing	Percent of elements	Score	Existing	Percent of elements	Score
Neighborhood small streets: low vehicle traffic, high speeds but low speed limits, 1 lane per direction, used as cut throughs	Bike	Bike sharrows										1.5					
		Bike parking	1			1			1			1			1		
		Wayfinding/signage		33%	2		33%	2		33%	2	1	117%	5		33%	2
	Transit	Safe loading and unloading zones/stations	1			1			1			1			1		
		Well located stops/stations	1			1			1			0.5			1		
		Bus shelter	1	100%	5	1	100%	5	0.5	83%	5	1	83%	5	1	100%	5
	Pedestrian	Curb extensions/bulbouts/painted safety zones							1			1					
		Chicanes, traffic calming	1			1			1								
		Raised crosswalks (raised intersections)															
		Accessible pavement conditions				1			1			1			1		
		High visibility continental crosswalks	1			0.5			0.5			1.5			1.5		
		Improved corner sight distance (daylighting and stop bars)	1						1			1			1		
		Speed humps	0.5														
		Near slow street	1	56%	3	1	44%	3	1	69%	4	1	69%	4	1	56%	3
	Comfort and aesthetic	Parklets				1			1			1					
		Bioswales, landscaping	1			1			1			1			1		
		Street furniture	1			1			1			1					
		Tree coverage and sustainable landscaping	1	75%	4	1	100%	5	1	100%	5		75%	4	1	50%	3
Notes			Perpendicular parking 7 and N line Sight distance could be impeded by per No bike infrastructure besides parking two slow streets nearby			one slow street train lines and traffic calming lots of parklets no lights, yield on one intersections (for train)			Near slow street perpendicular parking chicanes			Near slow street L train is closest transit Bike lanes Yellow crosswalks Perpendicular parking			Bike share docking station Yellow continental Feels safe Stop signs Perpendicular parking facing andronicos		

Scoring	
Score	Percent
1	1-20%
2	21-40%
3	41-60%
4	61-80%
5	81-100%

Appendix 5: Composite accessibility score

Walking

Normalized 0-5 for Study Area

Stores	Gravity Index	Infrastructure	25% infrastr	50% infrastructure	75% infrastr
1 Manila Orier	1.7	2.0	1.75	1.83	1.92
2 Safeway - M	2.0	3.0	2.26	2.51	2.75
3 Whole Foods	1.9	4.0	2.40	2.93	3.47
4 H Mart San F	1.4	3.0	1.79	2.20	2.60
5 Pacific Super	1.8	3.0	2.13	2.42	2.71
6 Alemany Far	0.9	3.0	1.43	1.95	2.48
7 Grocery Outl	0.9	3.0	1.46	1.97	2.49
8 Grocery Outl	0.7	3.0	1.24	1.83	2.41
9 Safeway - M	1.2	4.0	1.91	2.60	3.30
Average			1.82	2.25	2.68

Normalized 0-5 for Sunset

Stores	Gravity Index	Infrastructure	25% infrastr	50% infrastructure	75% infrastr
1 Other Avenu	1.9	3.0	2.21	2.47	2.74
2 S&B Superm	2.0	5.0	2.76	3.50	4.25
3 22nd and Irvi	1.8	5.0	2.61	3.41	4.20
4 Whole Foods	1.7	5.0	2.53	3.35	4.18
5 Sunset Super	1.9	3.0	2.21	2.47	2.74
6 Gus's Comm	2.1	4.0	2.57	3.05	3.52
7 Boss Superm	2.7	4.0	3.00	3.34	3.67
8 Noriega Foo	2.4	4.0	2.80	3.20	3.60
9 Superb Gard	2.2	4.0	2.65	3.10	3.55
10 Safeway	2.4	4.0	2.78	3.19	3.59
11 SM Superma	5.0	4.0	4.75	4.50	4.25
12 Lucky	1.8	3.5	2.22	2.65	3.07
13 Trader Joe's	0.9	4.0	1.67	2.45	3.22
14 Andronico's	0.9	4.0	1.68	2.45	3.23
15 Safeway	1.8	4.0	2.36	2.91	3.45
16 Sunrise Irving	1.3	3.0	1.72	2.14	2.57
Average			2.53	3.01	3.49
Max Raw Score	10.1				

Biking

Normalized 0-5 for Study Area

Stores	Gravity Index	Infrastructure	25% infrastr	50% infrastructure	75% infrastr
1 Manila Orier	1.5	0.0	1.2	0.8	0.4
2 Safeway - M	2.0	0.0	1.5	1.0	0.5
3 Whole Foods	1.9	1.0	1.6	1.4	1.2
4 H Mart San F	1.4	1.0	1.3	1.2	1.1
5 Pacific Super	1.6	0.0	1.2	0.8	0.4
6 Alemany Far	0.8	4.0	1.6	2.4	3.2
7 Grocery Outl	0.9	1.0	0.9	1.0	1.0
8 Grocery Outl	0.6	1.0	0.7	0.8	0.9
9 Safeway - M	1.2	1.0	1.1	1.1	1.0
Average			1.2	1.2	1.1

Normalized 0-5 for Sunset

Stores	Gravity Index	Infrastructure	25% infrastr	50% infrastructure	75% infrastr
1 Sunset Super	2.0	2.0	2.0	2.0	2.0
2 S&B Superm	2.0	1.0	1.8	1.5	1.3
3 22nd and Irvi	1.8	2.0	1.9	1.9	2.0
4 Sunrise Irving	1.7	3.0	2.0	2.4	2.7
5 Other Avenu	2.0	2.0	2.0	2.0	2.0
6 Gus's Comm	2.1	2.0	2.1	2.0	2.0
7 Boss Superm	2.7	0.0	2.0	1.3	0.7
8 Noriega Foo	2.4	2.0	2.3	2.2	2.1
9 Superb Gard	2.2	2.0	2.2	2.1	2.1
10 Safeway	2.4	2.0	2.3	2.2	2.1
11 SM Superma	5.0	5.0	5.0	5.0	5.0
12 Lucky*	1.7	2.0	1.8	1.9	1.9
13 Whole Foods	0.9	2.0	1.2	1.4	1.7
14 Trader Joe's	0.9	2.0	1.2	1.4	1.7
15 Safeway	1.8	0.0	1.4	0.9	0.5
16 Andronico's	1.3	2.0	1.5	1.6	1.8
Average			2.0	2.0	2.0
Max Raw Score	22.6				

Transit (8am Tuesday)

Normalized 0-5 for Study Area

Stores	Gravity Index	Infrastructure	25% infrastr	50% infrastructure	75% infrastr
1 Manila Orier	3.5	4.0	3.6	3.7	3.9
2 Safeway - M	4.6	3.0	4.2	3.8	3.4
3 Whole Foods	3.7	3.0	3.5	3.3	3.2
4 H Mart San F	2.7	1.0	2.2	1.8	1.4
5 Pacific Super	3.7	0.0	2.8	1.9	0.9
6 Alemany Far	1.8	3.0	2.1	2.4	2.7
7 Grocery Outl	2.0	4.0	2.5	3.0	3.5
8 Grocery Outl	1.6	4.0	2.2	2.8	3.4
9 Safeway - M	2.8	2.0	2.6	2.4	2.2
		Average	2.9	2.8	2.7

Normalized 0-5 for Sunset

Stores	Gravity Index	Infrastructure	25% infrastr	50% infrastructure	75% infrastr
1 Sunset Super	4.8	5.0	4.9	4.9	5.0
2 S&B Superm	5.6	4.0	5.2	4.8	4.4
3 22nd and Irvi	5.4	5.0	5.3	5.2	5.1
4 Sunrise Irving	5.1	5.0	5.0	5.0	5.0
5 Other Avenu	4.7	5.0	4.8	4.8	4.9
6 Gus's Comm	4.6	5.0	4.7	4.8	4.9
7 Boss Superm	5.9	4.0	5.4	5.0	4.5
8 Noriega Food	5.4	4.0	5.0	4.7	4.3
9 Superb Gard	5.1	4.0	4.8	4.6	4.3
10 Safeway	5.3	4.0	5.0	4.7	4.3
11 SM Superma	5.9	5.0	5.6	5.4	5.2
12 Lucky	4.3	4.0	4.2	4.2	4.1
13 Whole Foods	3.5	5.0	3.9	4.2	4.6
14 Trader Joe's	3.5	5.0	3.9	4.2	4.6
15 Safeway	4.8	4.0	4.6	4.4	4.2
16 Andronico's	3.2	5.0	3.6	4.1	4.5
Average			4.7	4.7	4.6
Max Raw Score	5.9				